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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1915.

JANUARY 19.

MR. CHARLES MORRIS in the Chair.

Thirty-one persons present.

The Publication Committee reported the receipt of papers under the following titles:

"On certain vesicles found in the integument of Ants," by Adele M. Fielde (January 8).

"The Praticolella of the United States," by E. G. Vanatta (January 13).

"Notes on the water-snake Natrix compressicauda," by T. Barbour and G. H. Noble (January 15).

"Notes on the Semelidæ of the West Coast of America, including some new species," by William H. Dall (January 16).

The death of Léon Vaillant, a correspondent, December, 1914, was announced.

Amendments to Chapters II, IV, IX, and XII of the By-Laws were adopted. They provide for the repeal of the initiation fee requirement, the loaning of certain books from the library, the control by Council of the frequency of its own meetings, and the holding of six meetings of the Academy during the year.

The following were elected members:

Heber Wilkinson Youngken,
George B. Benners.

The following were ordered to be printed:

OBSERVATIONS SUR LA THÉORIE GÉNÉRALE DES PHÉNOMÈNES GLACIAIRES ET SUR LES GALETS STRIÉS.

PAR STANISLAS MEUNIER.

I.

Ayant été depuis de longues années appelé à étudier d'une manière très approfondie de nombreux types de glaciers et de régions présentant des traces de glaciers maintenant disparus, il m'a paru qu'un certain nombre d'assertions acceptées par la majorité des géologues méritent d'être soumises à une sévère révision.

La conclusion de mes recherches, poursuivies avec le plus grand soin et avec le souci dominateur de me dégager de toute opinion préconçue, m'a amené à contester quelques faits, qui sont cependant classiques, et à leur substituer des notions qui cadrent beaucoup mieux, suivant moi, avec les grandes lignes de l'économie planétaire. J'ai eu souvent à recueillir à leur égard de précieux contrôles et même des vérifications complètes.

L'idée qui ressortira des pages qu'on va lire, c'est qu'un glacier considéré à part est un appareil qui, tout en remplissant son rôle dans la physiologie générale de la planète, est en proie, pour son compte propre, aux progrès d'une véritable évolution. Il débute dans une région qui offre les conditions favorables; il s'accroît au fur et à mesure de l'amplification de ces circonstances heureuses; il parvient ainsi à un moment d'apogée, après lequel il traverse des

chapitres de la Science qu'on a pris l'habitude de considérer comme complètement indépendants les uns des autres.

§ I. L'Origine des Glaciers.

La formation des glaciers suppose l'existence de deux conditions tout à fait primordiales: 1° la continuité d'une température ambiante inférieure à zéro; 2° un sol suffisamment incliné pour que la masse compacte soit animée d'un mouvement continu de glissement.

Il résulte de la que, sous les latitudes où la température moyenne de l'année est supérieure à zéro, un glacier ne peut se former que sur des points du sol convenablement élevés et atteignant en conséquence, des zones atmosphériques suffisamment froides, en raison du degré atmothermique. Cela peut s'exprimer en disant que l'origine des glaciers dans les régions situées en dehors des zones polaires, est liée directement à la surrection des montagnes, ou, si l'on aime mieux, à l'exercice de la fonction corticale.

On sait que la température de l'atmosphère decroît régulièrement, à mesure que l'on s'élève, de 1 degré par 185 mètres. Il en résulte qu'à une certaine altitude, il n'y a plus de vapeur d'eau dans l'air, mais seulement des particules glacées, des aiguilles cristallines qui se comportent comme des poussières atmosphériques et tombent lorsque l'air est calme. Quand elles parviennent dans des zones inférieures plus échauffée, elles se transforment en vapeurs et n'arrivent au sol que par les temps d'hiver.

Les sommets montagneux constituent des réceptacles tout préparés pour l'eau cristallisée, et, se couvrant de neige, deviennent, par contre-coup, des centres de rayonnement de froid.

Suivons donc d'abord l'évolution des montagnes pour arriver à celle des glaciers.

Le grand Plateau centre—asiatique, d'une altitude de près de 6,000 mètres, représente les premières étapes du phénomène de surrection de montagnes assez hautes pour recevoir la neige, avec une constitution très éloignée de celle des montagnes proprement dites.

Il résulte de l'étude des échantillons rapportés au Muséum National d'Histoire Naturelle de Paris, par M. Bonvalot et le Prince Henri d'Orléans, que les parties les plus hautes du massif Pamirien consistent en assises jurassiques fossilifères, qui n'ont aucune apparence des roches métamorphiques. Ce sont des calcaires argileux friables, très ressemblants à ceux qui entrent dans la constitution des régions françaises les moins tourmentées, comme les départements du Calvados et de l'Yonne.

Leur transport vertical jusqu'aux altitudes où ils atteignent maintenant, est le résultat de "bossellements généraux," qui nous apparaissent comme des contre-coups de travaux souterrains en rapports directs avec la production des montagnes. La comparaison avec maintes localités conduisent à une conception qui, bien que très directement connexe à l'histoire des glaciers, concerne cependant avant tout le chapitre orogénique. C'est que le mécanisme d'où résultent les montagnes est harmoniquement subordonné au régime général du globe qui doit traverser les phases successives d'une évolution véritable; qui doit en outre procéder aux modifications de son état général, sans compromettre les conditions d'équilibre de la surface, parmi lesquelles se signalent celles qui sont propres au développement de la vie.

Sans y insister, il est digne de remarque que l'écorce, forcée de suivre, dans sa contraction continue, le noyau fluide qui la supporte, doit se refouler sur elle-même, se doubler à la faveur de plis et de charriages, sans qu'il en résulte pour la surface autre chose que des tremblements de terre dont les plus graves ne déterminent jamais que des catastrophes locales, ne laissant après elles aucune trace *géologique* permanente.

Aussi bien, on peut considérer un massif du genre du Pamir comme contenant, en profondeur, une vraie chaîne de montagnes qui s'est soulevée lentement, après sa constitution, au titre de simple détail du grand ensemble en proie au bossellement général. Il faudra, pour que la montagne, caractérisée par sa structure bréchiforme et son état métamorphique, apparaisse au jour, que des actions externes la débarrassent de sa couverture de sédiments ayant échappé aux efforts mécaniques et aux actions calorifiques. De là, cette masse

[redacted]

entraîneront les boues épaisses et laisseront aux flancs des collines et dans les anses, les débris des hauteurs. Ces dépôts restent là jusqu'à l'été suivant, car l'hiver arrête le cours des fleuves. Puis, la chaleur du soleil agit; elle liquéfie les masses solidifiées; celles-ci s'ébranlent, coulent, s'emportent, reprennent les dépôts où elles les ont laissés à l'entrée de l'hiver et les enlèvent. D'année en année, étape par étape, elles finissent par les charrier toujours plus bas, sans cesse obstruant les vallées, élargissant les gorges, déviant les fleuves, étalant les deltas."[2]

Donc, les masses superficielles seront successivement démantelées, puis supprimées et le massif orogénique, refoulé et métamorphisé, se dégagera comme le produit d'une gestation et d'une véritable déhiscence de ses enveloppes protectrices. C'est comme un détail nécessaire du phénoméne, que nous apparaît la suppression des portions superficielles d'un pays dont le sous-sol a été refoulé souterrainement, par des successions généralement très nombreuses de séismes.

Ajoutons que les observateurs sont d'accord pour voir avant tout dans nos grandes chaînes, Alpes, Pyrénées, Caucase, Himalaya, des résidus d'érosion pluviaire. On est allé parfois jusqu'à dire que les Alpes ont dû perdre de cette manière, autant de substance qu'elles en ont conservé. C'est au cours de cette suppression, que les chaînes sont devenues peu à peu de vraies montagnes et qu'elles ont apparu au jour comme les "ossements composant le squelette de la terre" selon une expression restée célèbre.

Disons en passant que le tremblement de terre est la cause efficiente des montagnes qui, une fois édifiées par lui dans les profondeurs de

[2] Le Plateau thibétain, n'est pas plus une région glaciaire que la surface plane de la Sibérie, dans laquelle se trouve le point de température minimum de toute la surface terrestre. Nous trouvons, quant au régime des neiges, un exemple analogue dans la Terre de Grinnel, explorée par Greely, en 1889 (Voir: *Dans les Glaces arctiques*, p. 270 in 8° Paris 1889). "Cette île, située par 82° de latitude nord, est entourée d'une ceinture de glaciers et, malgré cette circonstance, elle présente dans son intérieur des régions relativement fertiles, où paissent toute l'année de très nombreux troupeaux de bœufs musqués (*Oribos moschatus*). Suivant l'expression du botaniste célèbre, Joseph Hooker, la Terre de Grinnel a "non pas un manteau, mais une ceinture de glaces." Et Greely écrivait: "La question des conditions physiques de l'intérieur de la Terre de Grinnell est résolue maintenant, comme l'ont fait pour la Terre Verte, les découvertes de Nordenskjold."

"Ces condition consistent, ajoute le voyageur, en ce que le terrain, montagneux et abrupt, ne permet pas aux neiges abondantes de l'hiver de se maintenir longtemps. De nombreuses vallées, longues et étroites, sont hérissées d'une quantité énorme de roches nues, dont les angles aident à concentrer la chaleur du soleil pendant l'été; ces vallées servent d'émissaires aux neiges fondues qui s'écoulent sur leurs falaises. Les riviéres de la saison chaude drainent le sol rapidement et longtemps, avant le retour des fortes gelées, toute la neige a disparu."

la croûte terrestre, sont mises progressivement à découvert, en attendant qu'elles soient ulterieurement supprimées par le jeu des actions externes, telles que la pluie et l'Océan. Exemple remarquable, par ses dimensions et par le contraste complet qui distinguent les unes des autres ses différentes phases, de ces cycles innombrables dont l'ensemble constitue toute la physiologie de la Terre.

C'est aussi le procédé par lequel s'élabore le genre de gisement favorable à l'établissement des glaciers. Et nous voici ramenés au cœur même de notre sujet.

L'érosion s'attaquant à la surface des couches soulevées par un bossellement général en même temps que le noyau orogénique q'elles recouvrent, en modifie progressivement la surface, d'abord continue et uniforme comme celle des grands fonds de mer. Ce travail, parallèle à l'œuvre de surrection qui peut se continuer pendant des périodes géologiques entières, favorise celle-ci en diminuant peu à peu le poids de la matière à soulever.

§ 2. Pouvoir de Transport des Glaciers.

Le glacier est un merveilleux appareil de condensation de l'humidité aérienne, qui s'y convertit en neige, puis se transforme en névé et en glace. C'est en même temps, un centre de dispersion aqueuse, car il s'y fait une évaporation active, même par le froid et surtout quand le vent souffle. Cette activité qu'il manifeste dans l'atmosphère, le glacier la déploie sur le sol, en transportant des particules rocheuses de toutes dimensions. Le poids n'intervient pas plus que la densité relative des débris: toutes les pierres, même les plus grosses, sont portées sur le dos du glacier. Ces sortes de "flotteurs" sont emportés comme les corps légers à la surface des rivières, et ils [redacted]

Enfin, les glaciers qui aboutissent à la mer précipitent de leur front au fond de l'eau, des quantités de matériaux que les courants ne laissent pas s'accumuler sous forme de moraine. Triés plus ou moins par grosseur et étalés en nappes qui prennent à certains égards l'allure des sédiments ordinaires, ils vont s'emmagasiner dans des fjords qui finissent par en être comblés. Et les icebergs, détachés du front terminal s'en vont, quelquefois fort loin, laissant tomber au fond de la mer des débris rocheux, de gros blocs essentiellement erratiques.

§ 3. Erosion glaciaire.

L'érosion produite par le glacier est considérable et très particulière. Il agit indirectement sur les formations qui l'environnent en activant l'intempérisme, c'est-à-dire en donnant un grand volume aux pluies et en provoquant des congélations locales qui désagrègent les roches. De plus, par sa faculté de transport, il prive constamment les parties érodées de la protection des éboulis, si efficace ailleurs.

Mais c'est surtout par son action directe sur sa vallée que le glacier travaille à la démolition de la montagne. D'après les observations de Dollfus-Ausset,[3] le glacier de l'Aar qui, avec ses affluents, n'a qu'une surface de 60 kilomètres carrés, fournit par jour 100 mètres cubes de sable qui sont emportés par le torrent. L'ablation des vallées par les glaciers est donc bien supérieure à celle que produisent la plupart des cours d'eau, à égale superficie de bassin.

Le sol sous le glacier, subit une friction considérable du fait des graviers et des pierrailles, véritable matelas interposé entre la glace et le roc. M. Vallot[4] a insisté sur ce fait que la voûte gelée, à la Mer de glace de Chamonix, n'est pas *moulée* sur le sol, mais lui est simplement tangente. Le torrent sous-glaciaire s'est ménagé un véritable tunnel.

L'efficacité érosive du glacier n'en fut pas moins longtemps contestée et n'est encore admise, par certains géologues, qu'avec des restrictions et comme à regret. Lapparent, dont le *Traité de Géologie* a la prétention de résumer l'opinion générale, a écrit en 1885:[5] "Nulle part, on n'a vu les glaciers creuser, affouiller un lit composé de roches dures, ni découper leurs parois comme font les torrents . . . Un glacier n'est donc pas, comme un torrent, un instrument efficace d'erosion . . . ; autant qu'on en peut juger, par ce qui se passe aujourd'hui, un glacier ne crée pas sa vallée, etc . . ."

[3] D'après Ed. Collomb memoires sur le glaciers actuels, *Annales de mines* (5)^e XI, 198.

[4] *Annales de l'Observatoire météorologique du Mont-Blanc,* III, Paris, 1898.

[5] 2^e édition p. 285.

En 1893, le même auteur faisait parler autrement l'opinion générale:[6] "On a beaucoup discuté, dit-il, sur la puissance d'erosion des glaciers. Quelques-uns la croient considérable; d'autres seraient portés à la regarder comme négligeable. La vérité semble se trouver entre ces deux extrêmes . . . En principe, puisque le glacier est un fleuve de glace dont l'allure ne diffère de celle des eaux courantes que par une vitesse incomparablement moins grande, il doit comme les fleuves tendre vers un profil d'équilibre et, tant que ce profil n'est pas atteint, le pouvoir de la glace doit s'employer à modifier en conséquence la forme du lit . . . Même les roches les plus durès du fond ne peuvent échapper à cette action, car les blocs que transporte la glace, poussés par une pression considérable, agissent sur le fond et les parois comme de puissants outils, etc."

Il y a bien longtemps que, pour ma part, j'ai soutenu l'opinion que les glaciers réalisent par le frottement dès pierrailles qu'ils entraînent sur les roches qui les supportent, un énergique travail d'érosion. J'écrivais en 1891:[7]

"Déjà j'ai eu bien souvent l'occasion de faire remarquer que la zone des roches moutonnées au-dessus de la glace dans les glaciers des Alpes et d'ailleurs, correspond à des points où la glace *n'atteint plus*, justement parce que, grâce à son action érosive, elle a pénétré verticalement dans la masse rocheuse sous-jacente. Elle est vraiment comparable à une scie, entrant dans une pièce de bois et qui bientôt se meut au-dessous des points qu'elle a sciés précédemment mais qui ne datent pas d'un temps où sa lame aurait été plus large."

"Ceux qui, dit Tyndall[8] ont soutenu que les glaciers creusent les vallées, n'ont jamais dit, ni voulu dire, que ce fût le *bec* du glacier qui agit dans ce cas. Pour le glacier de Morteratsch (Engadine),

L'attaque s'exerce même aux dépens des roches moutonnées. En effet, dans des excursions sur la Mer de Glace, aux Ponts et au Mauvais Pas, comme dans celles sur les glaciers de la Haute-Engadine et de bien d'autres régions, j'ai été frappé de ce fait que le poli des roches moutonnées qui dominent la glace, n'est pas le même à toutes les hauteurs: même de loin, on constate, très nettement en bien des points, qu'il est de plus en plus imparfait, c'est-a-dire de plus en plus altéré, à mesure que l'on s'élève. En outre, la limite supérieure des polis est loin d'être aussi nette que la limite supérieure du glacier et on voit des lambeaux de roches polies séparés de la masse générale des roches moutonnées, situées plus bas. Ces circonstances curieuses s'expliquent par la pénétration verticale du glacier dans la masse des roches qui le supportent, grâce à un mécanisme identique, à celui qui fait pénétrer dans une pierre le fil émerisé du lapidaire. En effet, l'âge des différentes parties du polissage est loin d'être le même: les parties hautes sont plus anciennes que les autres et, en conséquence, elles ont éprouvé plus longtemps l'action désagrégeante des intempéries; en même temps que les roches moutonnées gagnent par en bas, à cause de la pénétration verticale du glacier dans le sol, elles perdent par en haut, sous l'influence de l'intempérisme. On peut donc en conclure qu'elles ont pu jadis atteindre une altitude encore plus haute que celle qu'on observe aujourd'hui. De sorte que le procédé employé d'ordinaire pour restaurer les anciens glaciers devrait conduire à leur donner une dimension encore bien plus grande qu'on ne la suppose.

L'érosion glaciaire, soit directe, soit médiate, revêt si bien tous les traits essentiels de la dénudation fluviaire, qu'elle affecte une allure régressive, quant à son travail vertical, se traduisant par le phénomène de *Capture*, que j'ai reconnu dès 1897, et sur lequel nous reviendrons dans un moment.[11]

§ 4. Evolution des Glaciers.

Les glaciers doivent leur origine au soulèvement de la montagne, jusque dans les régions atmosphériques de température suffisamment basse; mais comme ils travaillent sans cesse à la démolir, elle subit une diminution de volume et surtout de hauteur qui entraîne le rapetissement du glacier. La neige reçue par le sommet étant moins abondante, la glace qu'elle produit par sa compression ne peut plus alimenter un courant aussi long que précédemment et le

[11] C. R. Acad. Sc. t. CXXIV, p. 1043 (10 mai 1897).

glacier abandonne, devant son front, une moraine terminale qu'il ne peut plus atteindre.

Il ne faut pas confondre le *recul des glaciers* avec les variations locales qu'ils subissent du fait de la météorologie, par exemple à la suite d'une série d'hivers peu neigeux. Le recul des glaciers passe par des alternatives, comme la mer descendante, dont la vague parfois semble regagner du terrain; le raccourcissement et l'allongement temporaire du glacier se perd dans l'allure général du phénomène, qui se retire peu à peu vers l'amont de la vallée, en laissant des moraines successives, très inégalement espacées, et entre lesquelles le sol offre seulement une dissémination de débris rocheux de toutes grosseurs: le terrain glaciaire *éparpillé* contrastant avec le terrain glaciaire *amoncelé*, dont le type est la moraine.

Le glacier qui diminue, change en même temps de forme: il perd la longue traînée qui descend vers les parties basses et se réduit à la portion élargie des régions élevées. Les Pyrénées, montagnes plus anciennes que les Alpes, et qui par conséquent subissent l'érosion depuis plus longtemps, nous offrent cette sorte de glaciers larges et courts, s'arrêtant au haut de vallées étroites, dont les flancs sont en beaucoup d'endroits parfaitement moutonnés et le long desquelles se montrent des moraines transversales, échelonnées de distance en distance, ce qui indique avec évidence que le glacier y a séjourné dans l'intervalle de ses raccourcissements successifs. Imaginons les Pyrénées remises en possession de tout ce qu'elles ont perdu depuis leur soulèvement, leurs sommets se retrouveraient dans les zones atmosphériques de fortes condensations neigeuses, et les cirques, mieux alimentés, reconstitueraient des glaciers semblables à ceux des Alpes.

rencontre pas le moindre vestige de glace. Des plaques de neige pourront se voir encore jusqu'en août, dans les creux abrités du soleil; mais en septembre, elles auront toutes fondu. Pour qu'elles persistassent, il suffirait d'un bien faible exhaussement des Vosges, d'une restitution à la chaîne d'une partie seulement des matériaux que l'érosion lui a arrachés et qui gisent, à l'état de moraines, dans la vallée du Chajoux et dans toutes les autres vallées qui rayonnent en tous sens.

Les Vosges ont été comme les Pyrénées; les Pyrénées seront comme les Vosges.

Certaines autres régions françaises, comme la Bretagne, le Cotentin, l'Auvergne, privées de glace et souvent même de moraines, ont cependant possédé des glaciers. On y rencontre en effet, à la surface de terrains variés, des blocs erratiques, semblables à ceux que charrient les glaciers et qu'ils abandonnent à leur moraine terminale. La détermination paraît d'autant plus légitime que les monts d'Arrée, par exemple, malgré leur altitude actuelle de simples collines, se révèlent par leur structure caractérisée, comme les résidus d'érosion d'une chaîne primitivement bâtie sur le modèle des Alpes. L'intempérisme a dispersé les moraines, attaqué les surfaces polies des roches moutonnées; il a laissé, provisoirement, quelques gros fragments rocheux particulièrement résistants.

L'appareil glaciaire s'est donc développé successivement dans les différents massifs montagneux, chaque fois que ceux-ci ont présenté une altitude suffisante pour y assurer la persistance de la neige. Successivement, les centres glaciaires ont occupé des régions différentes, et l'on peut croire qu'au total, les diverses époques se sont tres intimement ressemblé par le nombre et par le volume des glaciers développés durant chacune d'elles et seulement repartis differemment.

L'*émigration des glaciers*, comparable à l'émigration des continents mais dont la chronologie est plus difficile, faute de fossiles permettant de les dater, doit être substituée à la conception d'une *époque glaciaire*, dans laquelle les diverses traces glaciaires seraient contemporaines les unes des autres, où il y aurait eu beaucoup plus de glaciers que dans aucun autre temps, ce qui est essentiellement contraire à la marche, si évidemment continue et uniforme, de l'évolution de la surface terrestre.

La capture des glaciers est un point particulier et d'un haut intérêt de leur évolution. La capture est une analogie de plus, entre les cours d'eau solidifiée et les rivières. Comme ces dernières, des glaciers voisins doivent nécessairement réagir les uns sur les autres.

Imaginons deux glaciers A et B, remplissant deux vallées orientées à angle plus ou moins ouvert l'une sur l'autre, et disposées de telle sorte que le bassin supérieur de A soit séparé de la partie moyenne de B par une cloison rocheuse peu épaisse, la pente de A étant plus accentuée que celle de B. Dans ces conditions, la régression de tout l'ensemble du glacier A, amène l'amincissement de la cloison séparatrice en B, et plusieurs voyageurs ont directement observé le phénomène et en ont decrit les progrès, comme sir Martin Conway, en 1898, pour le Spitzberg,[12] et M. Williard D. Johnson, pour les Etats-Unis, en 1899.[13] Lorsque la destruction de cette cloison s'est enfin réalisée, et qu'alors le glacier A, en conséquence de sa pente plus forte, exerce une véritable succion sur la glace de B et la dérive à son profit, B est *décapité*, pour adopter l'expression employée à l'égard des cours d'eau, et A a réalisé la capture de la portion supérieure de B.

Le glacier A, conformément à la loi générale, avait subi une diminution consécutive à l'abaissement de son bassin d'alimentation sous l'influence de l'érosion; il avait abandonné sa moraine frontale et en avait édifié de nouvelles en arrière de celle-là; sur le terrain glaciaire éparpillé, s'était établi alors un régime continental ordinaire: production d'un étang ou d'une tourbière, avec débris organiques enfouis, animaux et végétaux. Mais voici la capture qui a lieu: une nouvelle contribution de glace vient s'ajouter au volume du glacier: il se gonfle, passe par dessus sa moraine frontale qu'il écrase et transforme en *moraine profonde*, s'avance sur la tourbière ou sur l'étang, en recouvre les formations de son dépôt éparpillé et récupère sa dimension primitive qu'il peut même dépasser.

Puis la diminution inéluctable reprend ses droits; le glacier recule de nouveau et finalement disparaît. Et si l'on est mis en présence

Bellegarde, y a reconnu les traces de plusieurs récurrences glaciaires séparées par des dépôts d'alluvions, indiquant plusieurs cycles d'érosion successifs. En effet, le nombre des nappes morainiques supérposées peut être supérieur à 2, par exemple de 3 ou de 4, ou même de 6, comme on le constate en certains points de l'Angleterre. Le fait tient au nombre de glaciers situés dans un même massif montagneux et qui ont pu entrer en communication.

Comment tous ces faits ne nous mettraient-ils pas en garde contre le danger évident qu'il y aurait à regarder les diminutions et les accroissements alternatifs de deux glaciers différents, comme ayant été exactement concordants dans le temps, c'est-à-dire non pas seulement de la même époque géologique, mais du même instant précis. C'est cependant parce qu'on eut cette idée inacceptable qu'on a cru à l'existence de périodes alternatives de grandes extensions et de reculs des glaciers. Manifestement il faut renoncer à cette conception qui restera dans l'histoire de la Science, comme le témoignage d'un moment d'aveuglement.

§ 5. Le Grand Phénomène erratique du Nord.

Nous savons que les glaciers polaires, aboutissant à la mer, ne peuvent se construire de moraines, mais qu'ils déposent le long de la côte, sous les eaux, une épaisse formations sédimentaire, et que chemin faisant, les icebergs entraînés par les courants, parsèment le fond de la mer de limons, de sables, de graviers, de pierres, quelquefois d'un volume considérable. Ce phénomène, qui s'est produit aux époques géologiques immediatement antérieures à la notre, a imprimé un caractère particulier au sol de vastes régions. Une partie de l'Europe, constituant comme une auréole autour de la Scandinavie et comprenant une large bande de l'Allemagne et de la Russie de l'Ouest dont le sol est relativement très récent, est couverte de matériaux éparpillés offrant le caractère glaciaire. Ceux-ci consistent en débris et parfois en très gros blocs de roches fort anciennes. Parmi ces roches, il en est de si reconnaissables qu'il est facile de déterminer leur lieu d'origine. Dans le nombre sont des calcaires à Orthocères venant, sans aucun doute, de l'île de Gothland, dans la mer Baltique, et des syénites zirconiennes, qui ont été arrachées aux rochers des environs de Christiana: les uns et les autres ont été transportés jusqu aux alentours de Berlin. La disposition des lieux est telle qu'on doit voir dans la dispersion de ces matériaux, le résultat de la dispersion d'icebergs ayant leur point de départ dans les Alpes Scandinaves et datant d'une époque où ces montagnes étaient couvertes de glaciers

pendant que les pays sur lesquels s'est étalé le "grand phénomène erratique du Nord" étaient submergés sous les flots d'une mer recevant les têtes des glaciers suédois.

La persistance d'un semblable phénomène à travers des périodes géologiques successives s'explique par un simple déplacement de la localité où il se développe. Si l'Atlantique venait un jour à se déssécher par suite du soulèvement de son fond au-dessus du niveau des mers, la ressemblance des effets qui s'y développent aujourd'hui avec ceux qui ont pris naissance antérieurement en Allemagne et en Russie pourrait porter à faire admettre que les deux régions ont été soumises *en même temps* au phénomène glaciaire; et l'erreur, cette fois si manifeste, accentuera nos remarques de tout à l'heure sur la non-contemporanéité des moraines ou des roches moutonnées, des diverses régions continentales.

Les traces du grand phénomène erratique se retrouvent en Amérique du Nord comme en Europe. Il irradie des sommets montagneux du Canada, qui se révèlent ainsi comme ayant, dans le passé, porté des glaciers aboutissant à un océan étendu, dans ce temps-là, sur les Etats-Unis.

Si l'on ne voyait pas l'Atlantique à l'œuvre et si l'on ne connaissait que les régions européennes et américaines couvertes de terrains erratiques, on ne ferait nulle difficulté de supposer qu'elles ont acquis leurs caractères spéciaux dans un même moment. La notion fournie par l'existence de l'Atlantique montre comment l'opinion contraire est plus vraisemblable et même comment il n'y a aucune raison de croire que toute la région européenne d'une part, et que toute la région américaine de l'autre, aient subi le phénomène erratique chacune d'un seul coup. Tout porte à admettre que la cause de

contre, elles se font voir de la manière la plus reconnaissable sur les fragments calcaires, particulièrement sur ceux de couleur sombre. Dans une moraine profonde qui n'a pas été remaniée et lavée par les eaux, presque tous les cailloux calcaires portent des stries qui souvent sont aussi profondes que si elles avaient été gravées avec un burin."[15]

Tout le monde à peu près, était en ce temps là du même avis, et cette quasi-unanimité en imposait assez aux dissidents pour qu'ils conservassent *in petto* les objections qui se présentaient à leur esprit.

On s'explique d'ailleurs jusqu'à un certain point l'erreur qui consiste à attribuer aux stries des galets une origine glaciaire et l'on comprend qu'une fois l'erreur commise on ait tenu d'instinct à la conserver, parce qu'elle semblait un guide commode dans la reconstitution de l'histoire géologique des glaciers.

Quant au premier de ces deux points de vue, il faut reconnaître que c'est surtout dans la masse des dépôts glaciaires, et avant tout dans les moraines, que les galets striés ont été observés. Par exemple, c'est sur les moraines des Vosges qu' Ed. Collomb[16] a fait les observations, pour ainsi dire initiales, qui ont été complétées par des expériences, prouvant que les galets striés passent à l'état de galets ordinaires, quand on les sommet à un frottement semblable à celui qui se développe dans le lit d'un cours d'eau.

On a conclu de ces observations qu'un glacier constitue un appareil des plus fragiles et que sa disparition totale doit suivre immédiatement l'envahissement par la mer de la région où il existait.

La première action des flots a été sans aucun doute de démanteler les moraines et d'en laver les matériaux hétérogènes. Le frottement leur a fait perdre les traits morphologiques qui pouvaient leur être caractéristiques et le balancement des eaux les a répartis rapidement en dépôts parfaitement classés, parfaitement distincts les uns des autres et n'ayant plus rien qui puisse les distinguer des sédiments ordinaires.

D'un autre côté, comme on retrouve des galets striés au sein de formations géologiques d'âges très divers, on a été enchanté, et à bon droit, de croire à leur autorité pour révéler l'action glaciaire à tous les moments de la vie de la Terre.

La première fois que j'ai eu des doutes sur l'origine glaciaire des stries, j'en ai ressenti une espèce de consternation et j'ai fait tout

[15] *Ueber Gletscher Erscheinungen in der bayerischen Hochebene; Bulletin de l'Académie de Munich*, 1874, p. 225.

[16] *Preuves de l'existence d'anciens glaciers dans les vallées des Vosges.* in 8° Paris 1847.

au monde pour ne pas céder à l'invitation, que semblaient me faire certaines particularités des Préalpes vaudoises, de me mettre en dissentiment avec l'immense majorité des géologues. Déjà, j'avais provoqué des résistances à l'occasion de bien des sujets différents, tels que la doctrine de la sédimentation souterraine qui me paraît cependant de plus en plus légitme; tels que l'origine, par réactions gazeuses, des roches silicatées magnésiennes de consolidation primitive; tels que la capture des glaciers; tels que le mode de creusement des vallées par les rivières et la constitution du diluvium; tels que le fait des relations stratigraphiques réciproques des divers types de méteorites; tels que beaucoup d'autres qu'il n'est pas nécessaire de rappeler.

Je dois avouer que j'eus un moment d'hésitation avant de me lancer dans l'exposition des faits qui me conduisirent à affirmer que, si dans les Préalpes vaudoises, d'anciens glaciers ont existé, ce qui est bien possible, ils n'ont laissé aucune trace de leur existence. En d'autres termes, que tous les accidents considérés comme des témoignages de l'ancienne existence des glaciers dans le pays, se rattachent avec évidence à des causes toutes différentes, et ne comportent pas les conséquences générales qu'on a cru pouvoir tirer de leur étude.

Je n'entrerai pas ici dans le détail de mes recherches, et je donnerai seulement deux observations.

Des spécimens recueillis au pied des Pléiades, au-dessus du village de Blonay, à 4 kilomètres au N. de Vevey (Suisse), consistent en galets de calcaire poli, présentant une prodigieuse abondance de stries et une extrême variété dans leurs directions. Toutes les faces de ces galets sont striées en tous sens. En outre, tous les galets calcaires contenus dans le sol sont semblables à ceux-ci par l'état de

(et dans le pays de Vevey ce n'est pas assez dire), elles auraient depuis longtemps disparu par le fait de la corrosion réalisée par les eaux d'infiltration. J'ai fait disparaître en moins d'un an le poli et la plupart des stries de galets que j'avais abandonnés dans la terre végétale à toutes les alternatives saisonnières.

Une coupe rencontrée sur la rive droite du torrent appelé la Baie de Clarens, qui descend du pied S. O. du Mont Folly, pour se jeter dans le lac Léman, m'a procuré des observations dignes de mention. Les travaux d'une route joignant Blonay à Charnex, avaient nécessité l'ouverture d'un énorme placage de terrain caillouteux, recoupé en face de Brent, suivant la pente du sol, par une tranchée de 200 mètres de longueur et dont les parois montraient le contact d'une surface trés inclinée de roches schisteuses, avec recouvrement épais de terrain caillouteux.

Cette ligne de contact est très inégalement inclinée selon les points: tandis que, dans certaines de ses parties, elle plonge très vite, dans d'autres, au contraire, elle est bien moins éloignée de la direction horizontale. Et la conséquence, c'est que les eaux d'infiltration ruissellent dans la masse avec une activité très inégale ici et là, et que le travail de la dénudation souterraine est d'être loin d'être uniforme d'un point à l'autre.

Dans le premier cas, et toutes choses égales d'ailleurs, on voit la boue beaucoup moins abondante, pendant que les galets calcaires sont très exactement polis et très richement striés; au contraire, dans l'autre cas, on observe des intervalles de niveaux limoneux et un excès de boue qui, bien loin de présenter la structure des moraines, permet de retrouver des formes de deltas superposés. En même temps, on reconnaît que les stries font à peu près défaut sur les galets calcaires.

Nous avons prononcé les mots "dénudation souterraine." C'est là qu'en effet, est la cause des stries sur les galets calcaires.

Beaucoup des caractères morphologiques de la surface du sol lui viennent d'actions souterraines dont ils sont le contre-coup.

Une partie des eaux courantes s'infiltre dans la terre végétale pour s'écouler à la surface de la roche sous-jacente. Quand la pente est convenable, l'écoulement détermine, l'usure de ce substratum, et des réseaux de dépression allongés se produisent avec l'apparence de vallées sans cours d'eau visible. Le manteau de sol arable s'affaisse peu à peu au cours de ce travail, sans cesser de persister, et tout en étant le siège d'un renouvellement incessant de toutes ses particules.

Dans les pays à forte pente, cette dénudation souterraine, toute voisine de la surface du sol, prend des caractères extrêmement intéressants. Pour observer les faits avec leur maximum de netteté il faut choisir une localité dont la roche vive soit recouverte de ces placages boueux à pierrailles de toutes les grosseurs, comme dans l'exemple que nous venons de citer.

Ces placages, quoique à base argileuse, sont cependant bien perméables, à cause du sable quartzeux qu'ils contiennent en proportion très notable et des blocs rocheux qui y sont disséminés; aussi l'eau d'infiltration y circule-t-elle avec une assez grande facilité.

Sous l'influence du liquide en mouvement, le terrain subit des pertes qui dérivent, les unes d'une dissolution de substances calcaires dans l'acide carbonique de l'eau de pluie, les autres d'un entraînement mécanique de particules argileuses qui troublent l'eau d'une façon très visible à la base des pentes et la rendent même tout à fait boueuse, quand les pluies sont fortes et prolongées.

La perte de matière qui provient de cette double cause est très notable et elle détermine nécessairement un tassement sur elle-même de la matière restante, qui glisse en même temps sur la roche supportant le placage boueux et qui, comme nous l'avons vu, est ici fortement inclinée.

Dans ce mouvement de contraction du terrain, il s'inflige pour ainsi dire à lui-même une nouvelle forme de la dénudation souterraine. A cause de son hétérogénéité, le déplacement relatif de ses grains durs et de ses éléments plus tendres amène l'usure de ceux-ci et souvent cette usure se manifeste par l'acquisition de détails morphologiques des plus remarquables.

Les grains de quartz de toutes grosseurs se montrant très [illegible]

souterraine et qui fait peu à peu des galets avec des blocs anguleux, se complique de la collaboration de ce déplacement intestin des grains de quartz par rapport aux débris calcaires sous l'influence de la dénudation souterraine.

En conséquence de la soustraction de substance soluble ou entraînable réalisée par l'eau d'infiltration, ces petits grains de quartz se meuvent sur la surface des blocs, lentement mais d'une façon continue, et avec une pression qui est mesurée par le poids du terrain superposé. Il en résulte que les surfaces convenablement tendres et avant tout, les surfaces de calcaire compacte, se polissent véritablement: comme elles se poliraient sous l'influence d'une molette, dans un atelier de marbrier.

Ce poli se renouvelle sans cesse: un galet poli enfoui dans la terre arable exposée à la pluie perd en très peu de temps sa surface caractéristique, il se ternit, il se corrode. Et c'est pour cela que nous pouvions tout à l'heure dire que, si de semblables galets avaient été polis par les glaciers quaternaires dans les placages où on les trouve maintenant, il y a un temps incalculable qu'ils auraient perdu le poli auquel on prétend les reconnaître. Mais dans leurs gisements, à mesure qu'ils sont attaqués, ils se polissent de nouveau et cela sans arrêt. Si la grande masse des petits grains quartzeux arrive à polir et à entretenir polis sous toutes leurs faces, les galets calcaires contenus dans les placages boueux des Préalpes, certains grains de même nature, mais de plus forte dimension, y impriment leur contact sous la forme de stries ou de rainures plus ou moins longues et plus ou moins profondes. Or c'est à cause des cailloux striés que certains géologues ont essayé de faire considérer les placages boueux des Préalpes comme étant d'origine glaciaire. Mais il y a impossibilité à soutenir cette opinion, par les mêmes raisons invoquées déjà à l'occasion des galets observés dans la masse d'anciennes moraines comme celles des Vosges. L'une des plus déterminante, c'est l'abondance même des stries, leur présence sur tous les galets calcaires sans exception et sur toutes les faces de ces galets. Involontairement, et malgré le respect que doit nous inspirer le nom de certains des géologues glacialistes que nous combattons, on ne peut se défendre d'un certain étonnement quant au succès d'une doctrine si insoutenable.

Les effets de dénudation observés à la surface des galets glacaires se retrouvent, avec les variantes qu'on peut prévoir, à la surface des roches calcaires sous-jacentes à certains placages boueux.

Le déplacement lent et incessant, sous une pression notable, des

grains de quartz au contact de calcaire compacte, a nécessairement usé celui-ci; toutes les aspérités y sont remplacées par de molles ondulations, par une forme moutonnée pareille à celle que les glaciers ont donnée aux roches qui ont subi leur friction. En vertu des circonstances mentionnées pour les galets, la surface moutonnée a été en même temps très exactement polie, et son poli est renouvelé constamment comme celui des galets. Enfin, cette roche a été, comme les galets encore, pourvue de stries et de sillons plus ou moins longs, plus ou moins nombreux, et tout cet ensemble reproduit dans ses traits généraux les effets déterminés par le passage des glaciers;—car il va sans dire que si les galets sont impuissants à strier les galets, ils sont au contraire très aptes à strier, à canneler et à polir les roches en place qui les supportent.

Mais un fait montrera à lui seul qu'il y a en jeu une cause essentiellement différente d'un cas à l'autre.

Rectifiant, il y a quelques années une route qui va de Glion au Mont Caux, on attaqua des placages boueux à galets striés et, dans un point, on mit à nu une magnifique surface calcaire moutonnée, polie et striée, offrant tous les caractères glaciaires, du moins aux yeux de géologues trop prévenus pour voir sainement les faits. Or, on reconnut que cette surface était seulement la partie supérieure d'un énorme bloc de plusieurs mètres cubes, noyé dans le placage boueux, et l'on voyait très nettement, dans certains points de ses surfaces latérales et même de sa surface inférieure, quej'ai pu aisément dégager en un point, la reproduction exacte du même poli et de la même striation. Cette pierre était donc un gigantesque galet pareil aux autres; elle avait été polie et striée ainsi en glissant avec une grande lenteur sur le terrain boueux sous-jacent.

cause d'obstruction travertineuse, les tuyaux de conduite établis pour capter ces eaux: j'en ai recueilli des échantillons très démonstratifs. Aux Avants et entre cette station climatérique et Montreux, la *tuffière* et d'autres monticules, représentent des amas de calcaire concrétionné émis par les placages. Il y en a un spécialement net au lieu dit *Sex que pliau* (la pierre qui pleut) au-dessus d'En Saumont, non loin de l'Alliaz; des feuilles et des coquilles terrestres y ont laissé des moulages parfaits.

J'ai pu assister véritablement à la production progressive du poli à la surface des blocs calcaires compris dans les éboulis, en étudiant successivement des escarpement choisis de plus en plus loin des sommets des Préalpes. Vers Sotodoz (1800 mètres), au pied des Rochers de Naye, les fragments rocheux dont il s'agit sont nettement anguleux et n'ont rien pour attirer l'attention; vers l'altitude du Mont-Caux, les arêtes vives et les parties anguleuses sont déjà devenues très rares et les blocs polis sont déjà très nombreux; leur maximum se trouve depuis les Avants jusqu'à Blonnay. Plus bas, la forme du pays cesse d'être favorable au glissement indispensable à la production qui nous occupe et l'on ne voit aucun galet.

Je suis arrivé à reproduire par l'expérience le phénomène de striation souterraine des galets et des surfaces rocheuses par un dispositif très simple.

Il était nécessaire de modifier les conditions naturelles tout en leur laissant leur caractère essentiel, de façon à leur faire produire un effet rapide et plus tangible. Pour cela, deux choses s'imposaient: 1° recourir à une substance beaucoup plus facile à rayer que le calcaire, puisque les forces mises en œuvre allaient être incomparablement plus faibles que celles qui interviennent dans les phénomènes naturels; —2° provoquer dans le sous-sol soumis à la dénudation, des mouvements plus accentués, afin de provoquer des résultats plus rapides. [Le premier point a conduit a employer des representations des galets en plâtre moulé, parfaitement lisses et polis. Pour cela on remplit de plâtre gâché de consistance très liquide, de petits ballons de verre, les uns sphériques et les autres ellipsoïdaux, c'est-à-dire du modèle dit des matras d'essayeur. Une fois le plâtre bien pris, on brise le verre avec précaution, à moins qu'il ne se brise de lui-même par dilatation du plâtre, et on enlève les fragments avec beaucoup de soin pour ne pas produire de rayures.

Le second point a conduit à adopter comme substance constitutive du sol artificiel, dans la masse duquel la striation devra se faire, un mélange, à volumes égaux, de sable quartz eux pas trop fin et de gros

sel de cuisine. Soumis à l'action de l'eau, ce mélange se réduira à la moitié de son volume et il sera le siège de déplacements intestins favorables à l'effet désiré.

Le mélange de sable et de sel est placé dans une boite rectangulaire en bois, et j'ai d'ordinaire employé 10 kilogrammes de sel et le volume correspondant de sable. Pendant le remplissage, qui se fait avec une pelle, on place successivement dans le mélange pulverisé, les boules de plâtre, de façon à ne point les frotter et par conséquent à ne point rayer leur surface. Quand la caisse est bien pleine, on dépose sur le mélange une planchette qu'on surcharge d'un poids de 20 à 30 kilogrammes. Il n'y a plus qu'à faire arriver au contact de la substance, un filet d'eau qui peut venir soit d'en haut, soit d'en bas, soit latéralement, pour avoir des effets très variés de tassements, avec glissements en sens divers. Après la dissolution totale du sel, on arrête l'expérience, on laisse égoutter, on ouvre la boite, en empèchant tout déplacement de son contenu et, avec les précautions les plus minutieuses, on extrait les boules qui sont lavées avec un jet d'eau et mises à sécher.

On observe alors à leur surface des paquets de stries qui ont avec celles des galets calcaires des placages boueux, les analogies les plus frappantes et les plus instructives.

C'est ainsi que les stries sont dirigées indifféremment dans tous les sens et le même sphéroïde peut en présenter en plusieurs directions. Après une seule expérience, elles sont peu nombreuses, mais on les multiplie aisément en remettant successivement les mêmes boules de plâtre dans l'appareil.

On peut aussi y placer une dalle plane en plâtre convenablement inclinée et obtenue par moulage dans une cuvette de porcelaine. Après l'écoulement on y voit des stries qui présentent le caractère

Zemble et identiques à ceux qui viennent du pays de Vaud. Ils ont été recueillis dans la moraine du glacier Jacques Costier, vallée de la Christovaïa, ainsi que dans une ancienne moraine du cap Stolbovos.

Thomson[19] décrit une "moraine" avec galets striés où la pluie détermine la production de cheminées des fées (*gigantic mushrooms*). "The morain is full of great polished subangular blocks in a matrix of finer material." On se croitait en présence des placages boueux des Préalpes vaudoises. Il faudra, quelque jour, refaire toutes les cartes de ces dernières régions pour supprimer la qualification de glaciaire donnée à cette formation.

Des faits complètement concordants avec ceux que j'ai décrits ont été signalés par le géologue anglais Bonney.[20] En en résumant ses résultats[21] M. Marcellin Boule a bien voulu ajouter: "On ne peut reprocher à M. Bonney que d'avoir oublié de, citer les travaux importants de M. Stanislas Meunier sur le même sujet. Depuis longtemps, en effet, le savant professeur du Muséum a montré qu'on prenait souvent dans les Alpes pour des moraines des accumulations de blocs et de boues dont l'origine est précisément celle qu'indique le géologue anglais. M. Stanislas Meunier va même plus loin. Il a montré par de curieuses expériences de laboratoire que les cailloux striés eux-mêmes peuvent se trouver dans les pseudo-moraines. Je suis heureux de rappeler ici les titres de priorité de M. Stanislas Meunier au sujet d'une question qui est pour nous de la plus haute importance."

L'interprétation des galets striés que je viens de développer, et qui me paraît devoir être définitivement adoptée, conduira comme première conséquence, à modifier sensiblement la carte géologique d'un très grand nombre de régions. Le signe adopté pour désigner les formations glaciaires devra y être remplacé par celui qu'il faudra choisir pour *les éboulis à galets striés*. Le long de la plupart des chaînes montagneuses et surtout des chaînes calcaires, il faudra lui réserver une zone assez large, aussi bien dans les Pyrénées et dans les Alpes, que dans une grande partie du Jura et dans les pays analogues.

Cette seule modification sera éloquente pour montrer l'illusion qui a conduit à supposer une ou plusieurs périodes glaciaires, en même temps que pour faire admettre dans la série des conditiones édificatrices de formations notables de tous les temps, la dénudation intempérique qui, dans les montagnes, accumule les éboulis sur les

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[19] *Travels in the Atlas and Southern Morocco*, p. 326 Londres 1889.
[20] *Geological Magazine*, janvier 1902.
[21] *L'Anthropologie*, livraison de mars, 1902.

surfaces convenablement inclinées. On est, en effet, très surpris à première vue que le phénomène des éboulis, si prédominant dans les montagnes soumises, à l'époque actuelle, aux actions météorologiques, semble n'avoir pas existé dans les périodes antérieures. La représentation à laquelle on arrivera nécessairement ainsi contribuera à faire ressembler, d'autant plus les unes avec les autres, les époques successives de l'évolution terrestre, en même temps qu'elle fera disparaître la singularité des temps glaciaires contrastant si étrangement avec la parfaite continuité qui règne sans partage dans tous les autres chapitres de la Géologie.

NOTES ON THE SEMELIDÆ OF THE WEST COAST OF AMERICA, INCLUDING SOME NEW SPECIES.

BY WILLIAM H. DALL.

In revising the Pacific Coast species in the National Collection, considerable confusion was found, due in part to the habit of Dr. Carpenter (who originally named the collection) of trusting to the specimens in the collection of Professor C. B. Adams rather than to the diagnoses of that careful author. The specimens in that collection, due to several causes (especially the fact that they were kept loose in trays and not numbered), have in some cases since Professor Adams' death become transposed or mixed, so that, without careful reference to the text, errors of identification were likely to occur.

Furthermore, the collection of the National Museum since Carpenter's time has been greatly enlarged, and the better and more numerous specimens from a much wider geographical range afford an opportunity for study not available to Dr. Carpenter.

Semele decisa Conrad, 1837.

San Pedro to San Diego, California. (Coll. U. S. N. Mus.)

This species is also reported from Mazatlan and Tagus Cove, Galapagos Islands, but I am not able to confirm these localities.

Semele solida Gray, 1828.

Peru and Chile. (Coll. U. S. N. Mus.)

This is also doubtfully reported from the Galapagos Islands. It is the *crocea* of Gould, 1850, and the *orbicularis* of Hupé, 1854.

Semele corrugata Sowerby, 1832.

Not of C. B. Adams, 1852; and probably the *californica* of A. Adams, 1853.

Magdalena Bay, Lower California, to Iquique, Peru. (Coll. U. S. N. Mus.)

It is possibly only a variety of the preceding or the following species.

Semele flavescens Gould, 1851.

Cape St. Lucas to Callao, Peru. (Coll. U. S. N. Mus.)

This is the *proxima* of C. B. Adams, 1852, and the *flavicans* of Carpenter (1857, lapsus) as of Gould.

Semele striosa C. B. Adams, 1852.

Not of Carpenter, 1857.

Catalina Island, California, to Panama. (Coll. U. S. N. Mus.)

This is one of the species which was confused with the following shell by Dr. Carpenter.

Semele sparsilineata n. sp.

Panama, 18 fathoms. (Coll. U. S. N. Mus., No. 96,269.)

Chile, Hupé.

This was confused by Hupé with *S. variegata* Lam., 1818, which it much resembles, but is easily discriminated from the Atlantic species by the much sparser oblique grooving. The best specimen in the National Collection is 15 by 10 mm., with the vertical from the beaks 6.5 mm. behind the anterior end; but the shell grows much larger.

Semele bicolor C. B. Adams, 1852.

Gulf of California to Panama. (Coll. U. S. N. Mus.)

A thin orbicular species with distinctive purple suffusion on a white ground.

Semele rupicola n. sp.

This is *Semele rupium* of California authors following Carpenter; not of Sowerby, 1832.

Santa Cruz, California, to the Gulf of California. (Coll. U. S. N. Mus.)

The Galapagos species, for which this has been mistaken, when not distorted by its nestling habit, has a conspicuous furrow radiating from the beak and rostrating the posterior end, and the form of the pallial sinus is different from that of the North American form. The former character is absent in the latter shell, but they are otherwise much alike.

Semele rubropicta Dall, 1871.

[redacted]

Semele regularis n. sp.

Gulf of California, off La Paz, in 10 to 30 fathoms. (Coll. U. S. N. Mus., No. 76,433.)

This is a thin, delicate, usually pure white species of elliptical outline, sculptured with low, obtuse, concentric lamellæ, regularly disposed, with fine concentric lineation between them and no trace of radial striation. The beaks are nearly central and the pallial sinus is high, short, subcircular, and hardly extends behind the vertical of the beaks. Some specimens have a faint orange flush internally. The most perfect specimen measures 22 mm. long, 17 mm. high, and 6 mm. in diameter. The umbo is about 12 mm. behind the anterior end. Fragments show that the shell grows at least one half larger.

Semele pacifica n. sp.

Catalina Island, California, to Acapulco, Mexico, in 9 to 21 fathoms. (Coll. U. S. N. Mus., No. 211,728.)

This is the shell usually referred to *S. cancellata* Sowerby, 1830 (*S. bellastriata* Conrad, 1837), but which differs from that Atlantic species in its smaller lunule, shorter and weaker right lateral tooth, and sharper and more delicate concentric sculpture. It is a rare form and doubtless the two descend from the same Oligocene ancestors.

Semele incongrua Carpenter, 1863.

Monterey, California, to the Coronado Islands, Lower California. (Coll. U. S. N. Mus.)

This is a well-defined species, and the Pliocene shell named *S. pulchra* var. *montereyi* by Arnold, 1903, should be referred to it rather than to *pulchra* as a variety.

Semele pulchra Sowerby, 1832.

Monterey, California, to Ecuador. (Coll. U. S. N. Mus.)

Semele venusta A. Adams, 1853.

Acapulco, Mexico, to West Colombia, South America. (Coll. U. S. N. Mus.)

The *S. rubrolineata* Conrad, 1837, San Diego, California, has not been definitely recognized since it was originally described, and the type is said to be lost.

It has been, by a lapsus, referred to by Dr. Carpenter as *S. rubrotincta*, and was surmised by him to be a variety of *S. pulchra*, but the two have no resemblance to each other, judging by Conrad's figure. There does not seem to be any good ground for doubting

the Chinese origin of *S. simplex* Adams and Reeve, 1848, to which *S. rubrolineata* has also been tentatively referred.

Abra pacifica n. sp.

Guaymas, Mexico. (Coll. U. S. N. Mus., No. 23,700.)

Shell small, thin, white, finely concentrically sculptured, giving the surface a silky look; the concentric lines slightly prominent on the dorsal part of the posterior end; beaks not prominent, slightly anterior, outline elongate, attenuated and pointed behind, rounded in front; with only faint traces of microscopic radial striæ or none; hinge normal, right cardinal tooth bifid, anterior right lateral stout, very short, posterior feeble, longer; left valve with a bifid cardinal and no laterals; pallial sinus obscure. Length 9, height 5.5, diameter 3.0 mm.

This is the first species of the genus reported from the Pacific Coast. It was collected by Dr. Edward Palmer.

Abra tepocana n. sp.

Off Cape Tepoca, Lower California, in 14 fathoms. (U. S. N. Mus., No. 108,552.)

Shell small, white, equivalve, anterior end longer; surface with a dull silky lustre due to extremely minute concentric striation; beaks rather prominent; dorsal margins descending, anterior end rounded evenly into a gently arcuate base, posterior end narrower, blunt, hardly truncate, slightly bent to the right as in a *Macoma;* right valve with a conspicuous resilifer, a very small cardinal tooth and the laterals obsolete; left valve with the cardinal hardly perceptible and no lateral laminæ; pallial sinus large, 5.6 mm. deep, rounded in front. Length 8, height 6, diameter 3.5 mm., the beaks behind the anterior end 5 mm.

NOTES ON THE WATER SNAKE NATRIX COMPRESSICAUDA.

BY T. BARBOUR AND G. K. NOBLE.

Natrix compressicauda[1] and its four hitherto described subspecies are confined wholly to Florida, where they inhabit the brackish lagoons and estuaries of the sea. Since specimens of this water snake are rare in collections, the systematic relationships of the several forms have not been thoroughly determined and any data on this subject should be of interest. Having examined some fifteen adults and a brood of fifteen young from the collection of the Museum of Comparative Zoology, we have found a remarkable variability in individuals from the same locality, while those from different localities have not shown any peculiar characters correlated with their distribution. The young from one brood are dichromatic and show many of the same variations as the adults, and seem to make it certain that there is but a single variable form to be recognized.

Mr. A. G. Reynolds, of Gulfport, Fla., who has collected a large proportion of the known specimens of *Natrix compressicauda*, is familiar with this variability of color in fresh specimens. In a letter of September 23, 1914, he writes:

"I have never found it anywhere except in brackish or salt water. Its local name is the 'salt-water moccasin.' The fishermen occasionally find it plentiful among the keys, but they never get me any specimens, although I offer a good price for them. It seems to be more or less plentiful at Key West. Here we get a straw-colored variety, also a variety with one row of spots beneath, and a variety with three rows of spots beneath."

With the exception of one specimen, the entire series in our collection was taken by Mr. A. G. Reynolds. All but one of these have been taken within the last few years and come from different parts of the region of Tampa Bay and Key West. One of the Tampa Bay specimens, kindly loaned for examination by the Academy of Natural Sciences of Philadelphia, comes from Tarpon Springs and was collected by S. N. Rhodes, in 1896. The others from this region were taken at St. Petersburg by Mr. Reynolds.

[1] Kennicott, *Proc. Acad. Nat. Sci. Phila.*, 1860, p. 335.

Of the Key West specimens there is one (M. C. Z. 2,444) worthy of special note. Cope[2] says in speaking of *N. c. compsolæma:*

"The only known specimen of this subspecies was found at Key West, Florida, and is preserved in the Museum of Comparative Zoology, Cambridge, Mass."

The specimen to which Cope refers cannot now be found in the museum. The only example which might be mistaken for it is No. 2,444. But this specimen came with another (M. C. Z. 2,446) of the same species, which also seems to have disappeared. Both were said to have been collected in the Florida Keys and probably at Key West by L. F. de Pourtales. They were given by him to the museum and were entered in the register by S. Garman in 1874.

That No. 2,444 cannot possibly have served Cope as the type of his *N. c. compsolæma* is shown by several noteworthy discrepancies. The tail and body lengths of the specimen (No. 2,444) are each some hundred millimeters longer than was Cope's type, and the dorsal rows are 21 as against the 19 given by Cope. Furthermore, the head shield characters of the two specimens are not the same.

Cope's type was probably not returned by him to the museum, and wide inquiry elsewhere has failed to locate it. Unfortunately, this is not the only specimen which suffered this fate.

THE DESCRIBED FORMS.

Cope[3] sums up the characters of the several races in respect to color as follows:

"*N. c. compressicauda* (Kennicott): numerous dark cross bands, which are resolved into three rows of spots just anterior to the tail, and four longitudinal stripes on the neck.

The body scale counts as given by Cope are:

N. c. compressicauda	$21\frac{131}{93}$
N. c. tæniata	$21\frac{131}{82}$
N. c. walkeri	$23\frac{137}{(?)}$
N. c. obscura	21 (?)
N. c. compsolæma	$19\frac{126}{67}$

The head shield characters of *N. c. tæniata* and *N. c. walkeri* are not treated very fully by Cope or Yarrow, while for *N. c. obscura* no scutation is given at all. Because the data given by Cope are incomplete, only the following can be expressed:

	Labials.	Pre- and postoculars.	Temporals.
N. c. compressicauda	8+10	1+3	1+3
N. c. tæniata	8+10	1+3	1+3
N. c. walkeri	8+10	1+3	1+3
N. c. obscura		Not given.	
N. c. compsolæma	8+ 9	1+3	?

Again, the length of the tail in percentage to total length taken from Cope would be:

N. c. compressicauda	28.8%
N. c. tæniata	25.9%
N. c. walkeri	?
N. c. obscura	?
N. c. compsolæma	21.5%

Lastly, a glance shows that the type locality of these "races" are all in the same faunal area. Two of the races came originally from Tampa Bay and two from Key West, while the remaining one was from the opposite side of Florida, taken at Volusia.

The Adult Specimens.

Trying to classify the fifteen adults under the five described races, we find that none conform in every detail to any one race, but that each one presents some of the characters from more than one "subspecies." Eight of these adults are from Tampa Bay, the other seven from Key West.

The coloration of the adults shows a gradual change dorsally from the dark brown to the light straw-colored phases and from the wide

to the narrow-banded conditions; ventrally from the two-lined form to one with a single row of spots anteriorly. The longitudinal stripes on the neck and the oblique body stripes typical of *N. c. compressicauda* are well defined on two specimens before us from St. Petersburg. There is another specimen from the same region which approaches *N. c. walkeri* in characteristic ground tone and markings, but the dorsal surface is darker and there is a vestige of the neck stripes found in *N. c. compressicauda* and *N. c. tæniata*. One Key West specimen follows the description of *N. c. compsolæma* almost exactly, while four others from Key West form distinct steps toward the typical *walkeri* pattern and coloration. Eliminating the three specimens from St. Petersburg, Tampa Bay, and the one from Key West which have a uniform straw-color and leaving out the one specimen from Key West that approaches *N. c. obscura* and which may be considered as melanistic, we have ten specimens remaining which seem to show a gradual change in pattern and color from *N. c. compressicauda*, through *N. c. tæniata*, *N. c. compsolæma*, to *N. c. walkeri*. Throughout this series no one character is distinctive enough to separate a race, although the Key West specimens all show a darker ventral surface. The straw-colored form is uniform and therefore has no distinguishing color characters, but the sooty variety approaching *N. c. obscura* seems to be a melanistic form of *N. c. compsolæma*, since its spots and faint bars have that arrangement.

The scale rows of the adult specimens present as pronounced a variation: there is no correlation between the color patterns and the number of scales and the counts given by Cope cannot be taken as differential characters of separate races. Two of the specimens before us have twenty-three dorsal rows, yet one has a color pattern

It is noteworthy that the sooty specimen like *N. c. obscura* in color has a very high scale count, it being $21\frac{134}{81}$, but since several other counts are nearly as large no significance can be placed on this. As only two of the fifteen specimens are females, and since these have average body scale counts, no sex differentiation is shown.

In the relative length of the body and tail the adult specimens vary greatly from the described forms. For example, the one specimen which follows so closely the description of the color of *N. c. compsolæma*, and which also came from Key West, has for its body-tail proportions 27.1%; Cope, on the other hand, gives measurements of 21.5%. The Tampa Bay specimens check up lower in average than the Key West ones. The range for the former being 22.6%–25.4%, average 24.1%, while the latter is 24.8–28.2%, average 26.1%. Since there is an overlapping of the high numbers of the former and the low ones of the latter and since the range of the whole series is not very great, races cannot be separated.

In the same way, the head scutation of the adults show great variation. For example, two of the male specimens from Key West (*A* and *B*) have a color pattern very similar to *N. c. walkeri*, their dorsal rows are both twenty-one, yet they differ considerably as shown below. Another specimen (*C*) from St. Petersburg is very similar to *N. c. compressicauda* in color pattern, it has twenty-three dorsal rows, yet its head characters are like those of (*B*).

	Key West. *A*	Key West. *B*	St. Petersburg. *C*
Labials	$\frac{9+10}{10+10}$	$\frac{8+8}{9+10}$	$\frac{8+8}{10+10}$
Oculars	$\frac{2+2}{1+1}$	$\frac{2+2}{1+2}$	$\frac{2+2}{1+1}$
Temporals	$\frac{1+4}{1+3}$	$\frac{1+3}{1+3}$	$\frac{1+3}{1+3}$

Moreover, as a whole this variability is very great, the ranges for individuals of the respective localities being:

	Tampa Bay.		Key West.	
Labials	$\frac{8+8}{10+10}$	– $\frac{9+9}{11+11}$	$\frac{8+8}{10+10}$	– $\frac{9+9}{11+11}$
Oculars	$\frac{2+2}{1+1}$	– $\frac{3+3}{2+1}$	$\frac{1+2}{1+1}$	– $\frac{3+2}{3+3}$
Temporals	$\frac{1+3}{1+3}$	– $\frac{2+3}{2+3}$	$\frac{1+2}{1+2}$	– $\frac{1+4}{1+3}$

In regard to the geographical distribution of these "forms," we have already spoken of their limited range. Although the museum has a series from Tampa Bay and Key West, no topotype of *N. c. taeniata* is at hand. Nevertheless, some of the specimens before us from Tampa Bay and Key West show most of the characters of this supposed race.

THE BROOD OF YOUNG.

The variability in color characters of the adults finds correlation in a brood of fifteen young born from a specimen similar to the typical *N. c. compressicauda*. The mother was taken alive by Mr. A. G. Reynolds and the young were born in captivity. They are distinctly dichromatic: one group, ten in number, being like the adult but with generally lighter ground color—in other words, approaching *N. c.* [illegible] while the others, five in number, are uniformly [illegible]-color as seen in some of the other adults. The [illegible] bands of the young vary somewhat in width, but there is not as much variation as we see in the adults. In fact, the young of this brood present in color only two or possibly three of the phases which are seen in the older individuals.

In comparing the scutellation of the young water snakes on the other hand, we find a great variability in the head shields and the [illegible]. The [illegible] have a constant number, [illegible], the same as the mother. The range of the [illegible] is as follows:

[illegible]

[illegible]

Regarding the relative length of body and tail, we would expect the proportion to run rather low since the brood comes from Tampa Bay. But this is not the case. The range is 25.5%–27.8%, average 27.1%.

From this it may be seen that but one race of *Natrix compressicauda* can be recognized.

ON CERTAIN VESICLES FOUND IN THE INTEGUMENT OF ANTS.

BY ADELE M. FIELDE.

During the years 1900 to 1907, I demonstrated by experiments, duly set forth in print, that the antennæ of the ant are a pair of compound noses, certain segments having each a special function. The ants in my formicaries were subject to observation by day and by night, all the year round. The experiments were unhurried, very numerous, and with adequate material for every series. No ant that had not manifestly recovered normal health after the required surgical operation was engaged in the service demanded by an experiment. (See *b*, page 425, and *j*, page 215.)[1]

I found that the habitual activities of the ants are guided mainly by diverse odors, produced by the ants themselves, and discerned through the sub-noses of the olfactory organs, the funicles of the antennæ.

These odors are: (1) the odor of the domicile, the nest aura, made up of the commingled odors of the

the abode of her enemies until her life pays the penalty of her unconscious temerity. This sub-nose appears to discern many odors, diffused in the air. (See *c*, page 539.)

(2) It is well known that ants of the same species abide in different colonies or communities so hostile to one another that an encounter between members of different colonies results in a battle, often prolonged until one or the other is exterminated. The undeveloped young of one colony are sometimes stolen and reared by the adults of another colony of the same species, but the adults of different colonies ordinarily maintain a mutual repugnance that is invincible, no matter how long an artificially enforced companionship may exist. The colony odor, depending on age, is discerned through the penultimate segment of the antenna. When this segment is eliminated, ants of different colonies of the same species live and work together in complete accord. They are then unaware of the objectionable odor of their comrades, as they no longer perceive what the normal ant discerns. The colony odor is discerned through contact of the antenna with the body of the ant subject to examination. This eleventh segment is, or contains, an organ of chemical sense which might be called olfactory or gustatory. (See *b*, page 449; *c*, page 531; *d*, page 609; *t*, page 1.)

(3) When an ant goes out from her dwelling, she lays down from her feet an odorous substance whereby she is guided on her return journey. She discerns her own scent through the antepenultimate segment of the antenna, and through the air. When this tenth segment is eliminated she is no longer able to retrace her steps and is completely bewildered. She is as incapable as is a dog in pursuit of a master who has waded. (See *c*, page 522.) But in her case the track remains, while power to pick up the scent has been destroyed in the pursuer.

(4) The next two segments of the funicle, the eighth and ninth counted from the proximal end of the antenna of *Stenamma fulvum piceum*, discern the odor of the queen and of the undeveloped young ordinarily her progeny. When these segments are eliminated, the worker ant, that in her normal condition evinced extreme devotion to the welfare of the inactive young and to the queen-mother, becomes wholly indifferent to all or any of those whom she has heretofore served. There are indications that the inactive young, as well as the queen, have a progressive odor, appreciable to the workers both by contact and in the air, and that the odor is a distinctive one, alluring to the workers. (See *c*, page 542; *k*, page 229.)

(5) The next two segments, the sixth and seventh from the proximal end of the antenna, discern the odor of ants of alien species, always regarded and treated as enemies unless acquaintance has been made in the earliest days of the individual ant's existence. Prolonged warfare and terrible slaughter often occur between ant colonies of different species. But if the sixth and seventh segments of the antennæ be eliminated, ants of different species or even of different sub-families will live together amicably and will regurgitate food to one another. I have had representatives of so many as five different genera living in close fellowship in the same nest. The specific odor is discerned by contact, the antenna being applied to some part of the body of the ant encountered. (See *h*, page 321; *k*, page 229.)

The two antennæ of the ant are identical in function, either one serving the purposes of both. Among the three or four thousand species of known ants the number of segments in the antennæ varies from four to thirteen. In my work of ascertaining the function of the antennal segments, I used mainly *Stenamma fulvum piceum*, a Myrmicine ant, having twelve segments in the antennæ. It is not improbable that further investigation, equally painstaking, would reveal olfactory functions in other segments than those tested by me. It is certain, however, that segments proximal to the sixth do not discern the odors appreciated by the seven at the distal end.

Since the ants have given evidence that they bear in their bodies several different odors, they must have glands producing unlike odors. The nest aura requires no separate apparatus, because its creation is effected by the combined odors of the inhabitants of the nest. The colony odor, inherited from the queen and changing with

ant has been long continued, highly skilled and very prolific, shows these organs as a pit communicating with the external air by means of a pore. They have been variously named. I suggest to myrmecologists the possibility that these vesicles found in groups or scattered over the body and limbs of the ant may be the producers of the odors borne by the insect, and I urge research among Forel's "inverted flasks," the "pits and pegs," the "plates and pores," and all papillæ on the ant.

Dr. N. E. McIndoo, of the Bureau of Entomology at Washington, D. C., has issued two papers, one in April, 1914, *The Olfactory Sense of the Honey Bee,* and one in November, 1914, *The Olfactory Sense of Insects.* I venture a few brief comments thereupon.

Dr. McIndoo quotes Dr. W. M. Wheeler's objection to my discovery that "the olfactory organs of an animal may exhibit 'regional differentiations.'" This objection, unsupported as it is by physiological tests applied to the ant, should influence no investigator. If there be error in the process of experimentation or flaw in the logic of the deduction, the critic should indicate the point of departure from a correct course. It is true that my statements are "unsupported by other observers," but lack of support by other observers is a misfortune that necessarily befalls the research worker who makes the earliest observation.

Dr. McIndoo's iterated statement that his bees were "abnormal," without definite indication of the cause or kind of abnormality, gives no assistance in the formation of a sound judgment concerning the changes due to mutilation. "Abnormality" of some sort is a natural consequent of mutilation. The question is whether a certain abnormal condition invariably ensues from a particular mutilation.

In those cases where Dr. McIndoo's surgical operations upon his bees were performed by the pulling apart or the burning off of segments, the lesions produced in the adjacent tissues must have been such as to seriously affect the functions of the parts subject to subsequent observation.

The odors of the essential oils used in his experiments must have been diffused through the air, and the reaction of the bees, normal or abnormal, may in many cases have been due to the effect of the odorous particles upon the trachea through the spiracles rather than to their appeal to the sense of smell.

Dr. McIndoo's experiments and observations appear to me to be confirmatory rather than contradictory of the view of most ento-

mologists that the antennæ are the organs of smell in insects. The evidence he sets forth is far from being convincing of the truth of his final asseveration that "the antennæ can no longer be regarded as the seat of the sense of smell in insects"; and equally remote from acceptance should be his conclusion that the organs he chooses to call "olfactory pores" "are the true olfactory apparatus in Hymenoptera."

List of Miss Fielde's Published Papers on Ants.

(a) Portable Ant Nests. Biological Bulletin, Vol. II, No. 11, September, 1900.

(b) A Study of an Ant. Proceedings of the Academy of Natural Sciences of Philadelphia, July, 1901; issued September 4, 1901.

(c) Further Study of an Ant. Proceedings, October, 1901; issued November 22, 1901.

(d) Notes on an Ant. Proceedings, September, 1902; issued December 4, 1902.

(e) Supplementary Notes on an Ant. Proceedings, June, 1903; issued September 4, 1903.

(f) Experiments with Ants induced to Swim. Proceedings, September, 1903; issued October 3, 1903.

(g) A Cause of Feud between Ants of the same Species living in different Communities. Biological Bulletin, Vol. V, No. 6, November, 1903.

(h) Artificial Mixed Nests of Ants. Biological Bulletin, Vol. V, No. 6, November, 1903.

(i) Observations on Ants in their Relation to Temperature and Submergence. Biological Bulletin, Vol. VII, No. 3, August, 1904.

(j) Portable Ant Nests. Biological Bulletin, Vol. VII, No. 4, September, 1904.

(k) Power of Recognition among Ants. Biological Bulletin, Vol. VII, No. 5, October, 1904.

(l) Reactions of Ants to Material Vibrations. Proceedings, September, 1904; issued November 2, 1904.

(m) Three Odd Incidents in Ant Life. Proceedings, September, 1904; issued November 2, 1904.

(n) Tenacity of Life in Ants. Biological Bulletin, Vol. VII, No. 6, November, 1904.

(o) The Sense of Smell in Ants. The Independent, August 17, 1905.

(p) [illegible] October, 1905. [illegible] Magazine [illegible] New York, April, 1906.

FEBRUARY 16.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

One hundred persons present.

The deaths of George J. Scattergood, July 16, 1914, and of Benjamin Sharp, M.D., January 23, 1915, members, were announced.

On the announcement of the death of Dr. Sharp, the following was read by the Recording Secretary and ordered to be placed on the minutes:

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA desires to place on record its sense of the loss sustained by the society and by the scientific world in the death of DR. BENJAMIN SHARP, on January 23.

Dr. Sharp graduated in medicine from the University of Pennsylvania in 1879. He subsequently studied in the Universities of Berlin, Leipzig, and Wurzburg. Immediately after securing his degree of Doctor of Philosophy from the last named institution in 1883 he published his first paper in the PROCEEDINGS of the Academy, a reprint of his graduation thesis on the anatomy of Ancylus. He subsequently published twenty communications as contributions to the PROCEEDINGS. They cover a wide range of subjects, but are most important, perhaps, as studies of the visual organs of mollusks.

Dr. Sharp was elected Corresponding Secretary of the Academy in 1890 and served efficiently until 1902.

His work as an attaché of the United States Fish Commission, as zoologist of the first Peary Arctic Expedition, and as professor in the Academy, the University of Pennsylvania, and in the Central High School, together with his explorations of Behring Sea, the West Indies, and the Sandwich Islands, was all prosecuted in direct association with the Academy, to which he was always most generous in the expression of his obligation for encouragement and assistance.

Dr. Sharp was endowed with a retentive memory and the faculty of clear and accurate statement. He was a man of singular personal charm and of an unusual range of sympathy and accomplishment. A strikingly attractive figure anywhere, he was equally at home in a scientific meeting, a drawing-room, or on the dock with his chums, the fishermen. He retained to the last the qualities of an eager, ingenuous boy without any of the disadvantages of immaturity.

Although not intimately associated with the Academy since 1902, his periodical visits sustained his affectionate relations with his fellow-members and testified to his loyalty to the institution.

The realization of its own loss in the death of Dr. Sharp

enables the Academy to appreciate the bereavement of his wife and children, to whom is extended its heartfelt sympathy.

Mr. Robert Cushman Murphy spoke on bird-life at an outpost of the Antarctic. The communication was beautifully illustrated [illegible]

[illegible]

A NEW CLASSIFICATION OF THE OPHIUROIDEA: WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

BY H. MATSUMOTO.

CONTENTS.

INTRODUCTION.

The present study was undertaken at the suggestion of Prof. Goto, of the Imperial University of Tokyo; and to him my hearty thanks are due for supervision and the revision of part of the manuscript.

My first purpose was merely to identify and name species. But

I soon found that the classifications of the Ophiuroidea hitherto proposed were very unsatisfactory. Indeed, their imperfectness became a haunt to me; so I determined to devise a new classification of my own.

For this purpose, I have dissected representatives of as many genera as were accessible; and the following are some of the more important results obtained:

A. *Morphological.*—Those forms that have arms capable of being vertically coiled, have a very compact oral skeleton (the adoral shields are entirely proximal to the oral shield, being firmly united to it; the oral frames are very stout, those of the same radius being firmly joined together; the peristomal plates are entire and more or less soldered to the oral frames, etc.), and very short, stout vertebræ, of which the articulation is streptospondyline, with a very rudimentary, or no articular peg. More or less divided vertebræ are found only in certain genera with horizontally flexible arms; such vertebræ are of two kinds, those which are divided into halves by a single fusiform pore (found in forms in which the dorsal side of the arms is more or less unprotected), and those in which the two halves are separated by a series of small pores (found in forms with the dorsal side of the arms entirely protected). Forms with quadrangular and stout teeth have oral frames with well-developed alveolar wings for the attachment of voluminous masticatory muscles, etc.

B. *Systematic.*—[illegible] *Trichaster* and *Euryale* have a certain [illegible] by which they may be distinguished from either [illegible] *Astroschema*. *Asteronyx* and its allies have certain [illegible] characters in contrast to *Astrophyton*, *Astrocnida*. Gor-

During the present study, I have received great help from Dr. Hubert Lyman Clark, of the Museum of Comparative Zoölogy, in the loan of many precisely determined specimens from that Museum and in helpful advice; my best thanks are due to him. This paper is in fact an outcome of his suggestions. A more detailed monograph with illustrations will be published ultimately in Japan.

The outbreak of the present war has made it impossible for me to receive some specimens of Palæozoic ophiurans promised me by Dr. B. Stürtz, so that I am obliged to defer a revision and classification of Palæozoic ophiurans to the future.

The greater part of the present study was done in the Zoölogical Institute of the Imperial University of Tokyo, and the type specimens of all the new species described belong to it.

SENDAI, JAPAN, December 1, 1914.

Subclass I. **ŒGOPHIUROIDA** nov.

Ophiuroidea with external ambulacral grooves, and without ventral arm plates. Radial shields, genital plates and scales, oral shields and dorsal arm plates also absent. Ambulacral plates alternate or opposite; in the latter case, they may often be soldered in pairs to form the vertebræ. Adambulacral plates, *i.e.*, lateral arm plates, subventral. Madreporite either dorsal or ventral, often large and similar in shape to that of an Asteroid.

This subclass consists chiefly of Palæozoic genera.

The Œgophiuroida lack all the fundamental characters by which Recent ophiurans are clearly distinguished from Asteroids. Indeed, the distinction of the present subclass from the cryptozonial Asteroids depends merely upon the different development of certain common structures.

Subclass II. **MYOPHIUROIDA** nov.

Ophiuroidea without external ambulacral grooves, and with ventral arm plates. Radial shields, genital plates and scales, oral shields and dorsal arm plates usually present; but sometimes rudimentary or absent. Ambulacral plates opposite, usually completely soldered in pairs to form the vertebræ. Madreporite represented by one, or sometimes all, of the oral shields.

This subclass includes certain Palæozoic forms and all the ophiurans since the Mesozoic.

Order I. PHRYNOPHIURIDA nov.

Disk and arms covered by a skin. The radial shield and genital plate articulate by means of a simple face or a transverse ridge on either plate, without well-developed articular condyles and sockets. Peristomal plates large, entire, or sometimes double or triple. Oral frames entire, without well-developed lateral wings. Dorsal arm plates absent or very rudimentary; lateral arm plates ventral or subventral in position; dorsal side of arms largely unprotected.

Key to families of Phrynophiurida.

A—Lateral arm plates more or less subventral; arm spines not confined to ventral side of arm, but lateral or subventral in position; vertebræ not very short and stout, with not exceedingly stout wings; upper and lower muscular fossæ of vertebræ rather subequal; radial shields small or rudimentary,
OPHIOMYXIDÆ.

AA—Lateral arm plates and arm spines confined to the ventral side of the arm; vertebræ very short and stout, discoidal, with exceedingly stout wings; upper muscular fossæ of vertebræ extremely large, lower very small; vertebral articulation typically streptospondyline; radial shields long and bar-like.

a—Arms without rows of hook-bearing granules; arm spines covered by thick skin; adoral shields very stout,
TRICHASTERIDÆ.

aa—Arms annulated by double rows of hook-bearing granules; arm spines naked, or at most covered by thin skin; adoral shields rather small and inconspicuous, often separated from oral shields by small supplementary plates,
GORGONOCEPHALIDÆ.

entire, very thick, fused with oral frames, which are very stout; vertebræ rather short and very stout, many proximal ones discoidal, none divided into halves; wings of vertebræ almost equally thick laterally and dorsally; vertebral articulations streptospondyline; articular peg very rudimentary, or absent...OPHIOBYRSINÆ.

Subfamily 1. OPHIOMYXINÆ Ljungman, 1871 (emend.).

(Characters as given above in key.)

This subfamily includes *Ophiohelus*, *Ophiosciasma*, *Ophiogeron*, *Astrogeron*, *Ophiocynodus*, *Ophiostyracium*, *Ophiosyzygus*, *Ophioleptoplax*, *Ophioscolex*, *Neoplax*, *Ophiomora*, *Ophiomyxa*, *Ophiodera*, *Ophiohymen*, and provisionally *Ophiambix*, besides two new genera, *Ophiostiba* and *Ophiohyalus*.

OPHIOSTIBA gen. nov.

Disk covered by a skin containing a number of scattered granules. Radial shields very rudimentary, forming a continuous row with the marginal disk scales, which are well developed, as in *Ophiomyxa*, *Ophiomora* and *Neoplax*. Teeth and oral papillæ present, with acute ends. Arms skin-covered; dorsal arm plates absent, while the lateral arm plates are subventral, so that the dorsal side of the arms is largely naked. Distal vertebræ more or less divided into halves by a longitudinally fusiform pore. Arm spines few, all converted into compound hooks. Tentacle scales absent.

This new genus differs from *Ophioscolex* chiefly in the presence of the marginal disk scales and in the conversion of the arm spines into compound hooks; and from *Neoplax* in the fewer arm spines, which are converted into compound hooks, and in the absence of tentacle scales.

Ophiostiba hidekii[1] sp. nov.

Diameter of disk 3.5 mm. Length of arms 16 mm. Width of arms at base 0.8 mm. Disk hexagonal, with concave interradial borders, covered by a soft skin, which contains a number of scattered granules. Radial shields very rudimentary and insignificant, forming a continuous row with the marginal disk scales, which are well developed. Genital slits very small and short.

Oral shields rhomboidal, with perfectly rounded outer and lateral angles, convex, slightly longer than wide; each serving as a madre-

[1] Dedicated to the memory of my friend, Hideki Chiba, who met with an untimely death a few days after assisting me in dredging my material in the Sagami Sea.

porite. Adoral shields long and narrow, but with widened outer ends, meeting each other within. Four or five oral papillæ on either side, triangular, with acute apices. Teeth stout, triangular, acute.

Six arms, of which three are longer than the other three, as an indication of schizogony. Dorsal arm plates entirely absent; dorsal side of vertebræ clearly visible. Lateral arm plates low, meeting below. First ventral arm plates very small, rhomboidal, longer than wide; the following heptagonal, with strongly concave proximo-lateral and outer sides (the former adjoining the tentacle pores), much longer than wide, widest opposite the outer ends of the tentacle pores; calcification very feeble along median line, the plates appearing as if longitudinally grooved. In the outer half of the arm, the vertebræ are more or less divided into halves by fusiform pores. Two or three hyaline arm spines, converted into compound hooks, with four or five denticles along the abradial side; the lowest one is slightly shorter than the upper ones, which are about two-thirds as long as the corresponding arm joint. The uppermost spines of either side of successive arm joints are connected by a hyaline, web-like membrane, except on the basal and most distal joints. Tentacle pores large, without any scale. Color in alcohol: disk deep chocolate-brown, except the granules, which are white; arms brownish yellow.

Two specimens; Sagami Sea; 300 fathoms.

This new species evidently reproduces by schizogony, as indicated by the hetaractiny and the occurrence of six madreporites.

OPHIOHYALUS gen. nov.

Ophiohyalus gotoi sp. nov.

Diameter of disk 9 mm. Length of arms 28 mm. Width of arms at base 1 mm. Disk pentagonal, with concave interradial borders, very flat, covered by a thin skin. Marginal disk scales present, feeble. Radial shields rudimentary and insignificant, forming a continuous row with the marginal disk scales. Genital slits small and short, extending from outer end of adoral shield to that of second lateral arm plate.

Oral shields triangular, with perfectly rounded lateral angles, outer side slightly concave; two and a half times as wide as long. Adoral shields large, triangular, very long, acutely tapered inwards, but not meeting. Oral plates long and narrow. The space encircled by the oral and adoral shields and oral plates is strongly depressed. Three or four oral papillæ on either side, thin, hyaline, serrate along the free edge. Two or three short, wide, flattened teeth, with rounded and finely serrate ends. Deep in the oral slit on either side of each jaw there occurs one conical, rough papilla, which protects the first oral tentacle pore.

Arms slender, covered by a very thin, transparent skin. Dorsal arm plates small, oval, thin, hyaline, longer than wide, wider within than without, separated from each other by naked spaces; they lie over the distal parts of the vertebræ of the corresponding arm joints, and become very small and delicate towards the extremity of the arm. Lateral arm plates low, slightly flaring, successive plates not in contact with each other, but separated by a naked space, which is widened upwards and continued into a large naked space bounded by the dorsal and lateral arm plates and the vertebra. First ventral arm plate not very small, quadrangular, with strongly curved outer side, much wider without than within; those beyond nearly rhomboidal in outline, with a conspicuous reëntrant notch at outer end and a half pore for the tentacle at each lateral angle; much longer than wide, widest opposite outer ends of tentacle pores; successive plates not in contact with each other, except within the disk. The lateral arm plates do not, however, meet each other in the ventral median line, so that there is left here a naked, depressed space, which is especially well-marked near the extremity of the arm. Except within the disk and at the very base of arms, the vertebræ are more or less or entirely divided into halves by fusiform pores, which become larger and longer in the more distal part of the arm. Arm spines two, subventral, unequal, glassy, all converted into compound hooks, with a series of hooklets along their ventral side, covered by

a thin, transparent skin; the lower one is much larger and longer than the upper. On some basal arm joints there occurs on the lateral arm plate one more spine, which is placed on the dorsal margin of the plate and also bears a series of hooklets on one side; it is larger and longer than the other two and nearly as long as the corresponding arm joint. No tentacle scale. Color in alcohol: yellowish white.

Two specimens; probably Sagami Sea.

Subfamily 2. OPHIOBYRSINÆ nov.

(Characters as given in key, p. 46.)

This subfamily includes *Ophiobyrsa*, *Ophiobyrsella*, *Ophiophrixus*, *Ophiobrachion* and provisionally *Ophioschiza*, besides a new genus, *Ophiosmilax*.

The Ophiobyrsinæ rather approach the next two families in skeletal characters.

OPHIOSMILAX gen. nov.

Disk and arms covered by a thick skin. Radial shields very rudimentary and insignificant. Single oral papilla on either side and two or three dental papillæ at the apex of each jaw. Teeth in a single vertical series. Teeth and papillæ all alike, stout, stumpy, conspicuously thorny at tips. Second oral tentacle pores open outside oral slits, each provided with a thorny, stumpy papilla, which arises from adoral shield. Dorsal arm plates absent, while the lateral arm plates are subventral, so that the dorsal side of the arms is merely covered by a naked skin. Ventral arm plates well-developed, in contact with each other. Vertebræ short and very stout. Vertebral articulation streptospondyline, the articular peg

scales. Radial shields rudimentary and insignificant, lying on the disk margin. Genital slits very small and short.

Oral shields triangular, with convex outer border. Adoral shields large, quadrangular, meeting within. Oral slits short, fairly closed up. Single oral papilla on either side, short, stumpy, conspicuously thorny at tip, turned up ventrally, instead of projecting towards oral slit. Two or three dental papillæ at apex of each jaw, similar in shape and in size to oral papilla, also turned up ventrally. Teeth in a single vertical series, stout, stumpy, thorny at tips. Second oral tentacle pores open outside oral slits, each provided with a stumpy and thorny papilla, which arises from adoral shield.

Arms stout in comparison with the small disk, covered by a thick, naked skin. Dorsal arm plates absent. Lateral arm plates subventral, strongly flaring. First ventral arm plate large, quadrangular, with rounded angles, slightly longer than wide, much wider without than within; those beyond also large, hexagonal; proximal and proximo-lateral sides very short; distal and disto-lateral sides long; outer angles perfectly rounded; as long as, or slightly longer than, wide, feebly calcified and transparent, except the outer and lateral margins, where the calcification is complete and opaque. Vertebræ short and very stout, with streptospondyline articulation, the articular shoulder and umbo being very stout, while the articular peg is entirely absent. Arm spines two or three, lying flat on the arm, all converted into compound hooks, hyaline; the uppermost two are subequal, about two-thirds as long as corresponding arm joint, while the lowest one is about half as long as the same. The smaller spines have two or three hooklets, which lie in one plane, while the larger ones have six or seven hooklets, which lie in two divergent planes. Tentacle pores small, without scales. Color in alcohol: brownish yellow.

One specimen; Sagami Sea; 300 fathoms.

Family 2. TRICHASTERIDÆ Döderlein, 1911 (emend.).

(Characters as given in key, p. 46.)

Key to subfamilies of Trichasteridæ.

A—More than three arm spines; madreporite single, ASTERONYCHINÆ.

AA—Two arm spines; all oral shields serving as madreporites.

a—Lateral arm plates of opposite sides separated from each other by the ventral arm plates, distal ones projecting ventrally like hanging rods; arm spines subequal; peri-

hæmal canal and genital bursæ communicating with each other.......... TRICHASTERINÆ.

aa—Lateral arm plates of opposite sides meeting each other in the ventral median line, distal ones not projecting ventrally like hanging rods; arm spines unequal, the adradial one being much larger and longer than the abradial and often clavate; perihæmal canal and genital bursæ not in communication; arms simple.......... ASTEROSCHEMATINÆ.

Subfamily 1. ASTERONYCHINÆ nov.

Disk very large, arms very slender and unbranched. A single madreporite is present. Perihæmal canal entirely closed. Peritoneal cavity divided into five compartments by the interradial attachments of the gastral pouches to body wall. Genital bursæ separated from the perihæmal canal and the peritoneal cavity, but the pairs of the same radius communicating with each other, the communication passing above the outer end of the oral frames and the first vertebra, just outside the perihæmal canal. Lateral arm plates of opposite sides separated by the comparatively large ventral arm plates. Arm spines, 3–8.

This subfamily includes *Asteronyx* and *Astrodia*.

Subfamily 2. TRICHASTERINÆ nov.

(Characters as given above in key.)

This subfamily includes *Ophiuropsis*, *Astroceras*, *Trichaster*, *Sthenocephalus* and *Euryala*.

Subfamily 3. ASTEROSCHEMATINÆ Döderlein, 1911 (emend.).

(Characters as given above in key.)

till the adradial one is distinctly clavate and is about twice as long as the corresponding arm joint. The color is light pinkish brown in alcohol. The type specimen is 16 mm. in disk diameter, 230 mm. in arm length and 4.5 mm. in arm width at base.

Two specimens; Okinosé (a submarine bank), Sagami Sea. One specimen; Sagami Sea.

Asteroschema glaucum Matsumoto.

1911, Dobuts. Z. Tokyo, **23**, p. 617 (in Japanese).

This species is near *A. salix* Lyman, but differs from it in coarser granules on disk and arm bases, in stouter arm bases, in much shorter arm spines, and in oral tentacles being enclosed in tubes. About six granules lie in 1 mm. on the radial ribs and free arm bases. Arms very stout at base, as high as wide. Arm spines longer and stouter outwards, till the adradial one is somewhat clavate and is slightly longer than the corresponding arm joint. Oral tentacles enclosed in tubes. First two or three tentacle pores also provided with tubes, though rudimentary. The color is pale gray in alcohol. The type specimen is 11 mm. in disk diameter, 100 mm. in arm length and 4 mm. in arm width at base.

Three specimens; Sagami Sea; 110 fathoms.

Asteroschema hemigymnum Matsumoto.

1912, Dobuts. Z. Tokyo, **24**, p. 381 (in Japanese); figs. 3, 4.

Diameter of disk 10 mm. Length of arms 120 mm. Width of arms at base 3 mm. Disk rather flat, divided into ten lobes, corresponding to the radial ribs, by ten radiating furrows; covered by a skin, which contains very fine, smooth, close-set granules. Ventral interbrachial areas rather vertical, narrow, forming a deep notch, on the floor of which opens one madreporic pore. Genital slits rather short, more or less divergent dorsally. Ventral surface of disk covered by a finely and rather sparsely granulated skin.

Oral angles not markedly set off from the outer parts. Six or seven teeth arranged in a single vertical row, triangular, very stout. On either side of the oral angles, there are several coarse, flat, smooth, pavement-like grains, which correspond to oral papillæ.

Arms very stout for the first three or four free joints, but becoming rather slender further out; their width just outside the fourth free joint is 2.5 mm. They constantly taper outwards, so that they are exceedingly slender towards the extremities, which are very acute. Dorsal and lateral surface of the arms covered by a skin, which is similar to that of the disk, containing very fine, smooth, close-set

granules, of which there are about five in 1 mm. on the dorsal surface of the arm bases. The granules become much finer outwards, and almost disappear near extremity of arm. Vertebræ visible through skin, but surface of arm practically smooth and without distinct demarcation of joints, except of first three or four, which are marked off by shallow constrictions. Ventral surface of arms entirely naked, and lateral and ventral arm plates clearly visible through skin. First tentacle pore unprotected; next four or five pores provided with a single arm spine, and the rest with two. Abradial spine very small, cylindrical, enclosed in skin, more or less rough at free end. Adradial one clavate, enclosed in skin, very rough at free end. Arm spines largest at middle of arm, the adradial one being one and a half times as long as, and the abradial one a little shorter than, the corresponding arm joint. They are transformed into compound hooks, with three to six hooklets, towards the very extremity of the arm. Oral tentacle pore and first three or four tentacle pores provided with tubes. Color in alcohol: grayish brown.

One specimen; Sagami Sea.

Like *A. intectum* Lyman and *A. migrator* Koehler, this species appears to be an intermediate form between the sections *Asteroschema*, s. str., and *Ophiocreas.*

Astrocharis ijimai Matsumoto.

1911, Dobuts. Z. Tokyo, **23**, p. 617 (in Japanese).

Diameter of disk 4.5 mm. Length of arms 50 mm. Width of arms at base 2.5 mm. Disk five-lobed, with deeply indented interbrachial borders, with lobes emarginate towards arms, flat, sunken at the central region, raised at the lobes, covered with very fine, smooth, irregular scales, which are very close-set and partly imbri-

scales similar to those of the disk. Arm joints invisible in the proximal part of the arm, but more or less distinct distally. First tentacle pore free of arm spines; those beyond provided with a single spine, which is very small, short, peg-like, somewhat flattened, rough at the end as seen under a microscope, lying flat on the ventral surface of the arm. Half way out on the arm, each tentacle pore is provided with two spines, of which the second, or abradial one, is exceedingly small and rather inconspicuous; the adradial one then becomes a little longer and erect to the arm. Color in alcohol: white or pale yellow.

Numerous specimens; Sagami Sea.

In smaller specimens, the arms are scarcely widened at the base, which is also the case in regenerating ones; for schizogony takes place in this species as in the genotype, *A. virgo* Koehler. Most specimens are five-armed, but the arms are often unequal, two or three being larger than the others. I have, however, one specimen with six arms, three larger and three smaller. In four-armed specimens, two or three arms may be larger and the other two or one smaller. Still another specimen has only three arms, doubtless indicating that it has lately undergone division, and that the lost parts have not been regenerated.

Family 3. GORGONOCEPHALIDÆ Döderlein, 1911.

(Characters as given in key, p. 46.)

Key to subfamilies of Gorgonocephalidæ (I).

A—Teeth, dental papillæ and oral papillæ all similar, spiniform; oral angles not strongly projected ventrally; genital slits small, often pore-like, lying near the disk border; basal vertebræ not very small, not covered over by the muscles between the basal vertebræ and genital plates, GORGONOCEPHALINÆ.

AA—Teeth and dental papillæ similar, spiniform; oral papillæ absent or, at least, extremely reduced; genital slits large, extending nearly from the inner corners of the interbrachial ventral surfaces to the disk margin; basal vertebræ very small, covered over by the muscles, which connect the basal vertebræ and genital plates .... ASTROTOMINÆ.

Key to subfamilies of Gorgonocephalidæ (II).

A—Arms simple or branched a few times.

a—Teeth, dental papillæ and oral papillæ all well developed; oral and adoral shields in direct contact with each other, without supplementary plates in the oral region, GORGONOCEPHALINÆ, pars.

aa—Teeth and dental papillæ well developed, but oral papillæ absent or very rudimentary; oral and adoral shields separated from each other by a mosaic of supplementary plates..ASTROTOMINÆ.

AA—Arms branched many times; teeth, dental papillæ and oral papillæ all well developed; oral and adoral shields separated from each other by a mosaic of supplementary plates, GORGONOCEPHALINÆ, pars.

Subfamily 1. GORGONOCEPHALINÆ Döderlein, 1911 (emend.).

(Characters as given above in keys.)

This subfamily includes *Astrogomphus*, *Astrochele*, *Astrochlamys*, *Asteroporpa*, *Astrocnida*, *Conocladus*, *Astroconus*, *Gorgonocephalus*, *Astrodendrum*, *Astrocladus*, *Astrospartus*, *Astroboa*, *Astrophytum*, *Ophiocrene*, *Astrochalcis*, *Astrogordius*, *Astrocyclus*, *Astrocaneum* and *Astrodactylus*.

Astrocladus annulatus (Matsumoto).

Astrophyton annulatum, 1912. Dobuts. Z. Tokyo, **24**, p. 206 (in Japanese); figs. 17, 18.
Astrocladus annulatus, 1912. Dobuts. Z. Tokyo, **24**, p. 389.

Diameter of disk, 22 mm. Distance from centre of disk to interradial margin, 8.5 mm. Distance from outer end of oral slit to first bifurcation of arm, 11 mm. Arms branched nineteen or twenty times, measuring about 125 mm. in total length. Width of ventral side of arm base within disk, 4.5 mm. Disk five-lobed, with concave interbrachial borders, covered by a thick skin, which is apparently smooth, but contains fine, close-set granules of microscopic size. On the radial ribs these granules are flattened, pavement-like and coarser, being even visible to the naked eye. Several smooth,

granulated skin, with several scattered, smooth, hemispherical tubercles on the more proximal shafts; distinctly annulated with hook-bearing segments throughout. Ventral surface of arms entirely smooth. Arm spines, which are present beyond first bifurcation, very fine and three or four in number at each tentacle pore. Color in alcohol: disk mottled and arms annulated with yellowish and grayish brown.

One specimen; Sagami Sea.

This species can be easily distinguished from other species of *Astrocladus* by the entirely smooth disk covering and by the arms, which are distinctly annulated with hook-bearing segments even at the very base.

Astroboa arctos sp. nov.

Diameter of disk, 65 mm. Distance from centre of disk to interradial margin, 25 mm. Distance from outer end of oral slit to first bifurcation, 32 mm. Arms branched about thirty-seven times, measuring approximately 420 mm. in total length. Width of ventral surface of arm base within disk, 17 mm.

Disk decagonal, with concave interbrachial and brachial borders, the former being longer and more concave than the latter; very high and convex, but with more or less depressed central region, covered by a thick skin, which is shagreened by the presence of very fine, close-set granules. The granules are smooth, not acute, irregular in size, when viewed under a microscope, the coarser ones being more numerous on the radial ribs than in the intercostal spaces. Radial ribs long, narrow, bar-like, widest at outer end, suddenly narrowed for a very short distance, then uniformly tapered inwards, nearly reaching disk-centre. Ventral interbrachial areas covered by thick, apparently smooth skin, which, however, contains fine, microscopical granules. Genital slits rather large, adradial border protected by a cluster of close-set spinules.

Madreporic shield, situated at inner angle of a ventral interbrachial area, more or less semilunar, with semicircular inner, and distinctly notched outer, side and rounded lateral angles. Areas proximal to ventral interbrachial regions, apparently smooth, but closely covered with very fine granules of microscopic size, the granules being rather coarse and distinct at the oral angles. Teeth and papillæ very numerous; oral and dental papillæ, rather small, spiniform, and not very acute; teeth, much larger and longer than papillæ, distinctly spatulated, and flattened at tip.

Two main stems, outside the first bifurcation, of an arm are not

equally developed, but one is longer, stouter and more branched than the other. Dorsal and lateral surface of arms covered by a thick skin, which is very finely and closely granulated; granules, irregular in size and roughly distinguished as of two kinds; finer ones entirely covered by skin, flat, irregularly polygonal, forming together a sort of mosaic; coarser ones, coarser than any granules of disk, hemispherical, tubercle-like, and uniformly scattered. Ventral surface of arms apparently smooth, but covered by a mosaic of flat and irregularly polygonal granules of microscopic size. First pair of tentacle pores distinct, opening in slight depressions; second often distinct; following three or four pairs entirely invisible; those beyond are again distinct. Arm spines absent on proximal joints, but occur from fourth or fifth bifurcation outwards. They are exceedingly minute and granule-like, two to four of them occurring at each tentacle pore. The double rows of hook-bearing granules are present only on very fine twigs, the main stems within fourteenth or fifteenth bifurcation being free from them. The shaft between the first and second bifurcations usually consists of four arm joints; the outer shafts consist of six to eight, usually seven joints. Color in alcohol, as well as when dry: dark grayish brown above, and dark yellowish brown below.

Two specimens; off Misaki Marine Biological Station; 5–10 fathoms. Four specimens; Sagami Sea.

Among the five known species of *Astroboa*, *A. clavata* (Lyman) is distinguished from the others by the spiny granules of the disk and arms, and *A. globifera* (Döderlein) by the position of the madreporic shield. *A. nuda* (Lyman) and *A. nigra* Döderlein have distinct annulations of hook-bearing granules on the arms throughout, while

Subfamily 2. ASTROTOMINÆ nov.

(Characters as given in keys, p. 55.)

This subfamily includes *Astrothrombus*, *Astrothorax*, *Astrotoma* and *Astroclon*, besides a new genus, *Astrothamnus*.

Astrothamnus gen. nov.

Disk divided into ten radiating lobes by radial and interradial furrows, closely covered with coarse granules or stumpy tubercles, which are acute or thorny at tips. Ventral interradial areas strongly concave, with large, long, more or less parallel genital slits. Teeth and dental papillæ similar, spiniform, forming a cluster at the apex of each jaw. Oral papillæ absent, so that the sides of the oral slits are naked. Arms simple, distinctly annulated by zones of densely set, minute, compound hooks; the interannuli are covered with coarse granules, which are arranged more or less clearly in two series. Arm spines 3–5, peg-like, usually rough at tips, serving as tentacle scales.

This genus includes Koehler's *Astrotoma bellator*, *A. vecors* and *A. rigens*, besides the genotype, *Astrothamnus echinaceus* sp. nov.

Astrothamnus is distinguished from genuine *Astrotoma* as follows:

A—Disk covered with coarse granules or stumpy tubercles, which are acute or thorny at tip; arms annulated by conspicuous zones of densely set compound hooks; interannuli of arms covered with coarse granules, which are arranged more or less clearly in two series.......... *Astrothamnus*.

AA—Disk covered with very fine, smooth granules, often beset with a number of smooth, stumpy tubercles; arms rather inconspicuously annulated, each annulus consisting of four rows of granules, the middle two hook-bearing, while the others are smooth; interannuli covered by a pavement of very fine granules, among which many oval, sunken plates are present.......... *Astrotoma*, restr.

In the arm coverings, *Astrothamnus* is similar to *Astrothrombus* and *Astrothorax*, while *Astrotoma*, restr., resembles *Astroclon*. Thus the Astrotominæ fall naturally into two groups, one of which includes the first three genera, and the other the last two.

Astrothamnus echinaceus (Matsumoto).

Astrotoma echinacea, 1912. Dobuts. Z. Tokyo, 24, p. 200 (in Japanese); figs. 6–8.

Diameter of disk, 22 mm. Length of arms, 140 mm. Width of arms at base, 4 mm. Disk distinctly five-lobed by five interradial furrows, each lobe being again divided into two secondary lobes by

the radial furrow. Radial ribs much raised, large, occupying almost the whole dorsal surface of disk, but leaving between them ten narrow furrows radiating from the centre; closely covered with rather large stumpy tubercles with thorny crowns, between which lie thick, irregularly polygonal plates. Ventral interbrachial areas strongly concave, closely covered with stumpy tubercles terminating with one or a few thorny points. Genital slits rather large, more or less parallel.

Madreporic shield small, irregular in outline. Areas proximal to ventral interbrachial regions closely covered with spiny, stumpy tubercles. Oral angles ventrally projected, covered with conical and acute tubercles, which become, near mouth, more or less indistinguishable from dental papillæ. Teeth and dental papillæ similar, conical, very acute. Oral papillæ absent; sides of oral angles naked.

Arms rather slender, long, uniformly tapered outwards, distinctly annulated by double rows of coarse granules, which are entirely covered with densely set, minute, compound hooks; interannuli covered with coarse, smooth granules arranged in two irregular rows. Ventro-laterally on either side of arm, in line with interannuli, there is a series of large, round, smooth plates. At the arm bases, the hook-covered annuli are usually broken in the dorsal median line by conical granules terminating with one or a few thorny points. Ventral side of arms with rather well-spaced tubercles, which are conical or terminate with one or a few thorny points; these tubercles become rounded and smooth distally. First and second tentacle pores free of arm spines; third with one or two spines; fourth with two or three; remainder with three. Arm spines of basal joints more or less indistinguishable from conical or thorned tubercles,

arm spines and in the presence of a series of large plates on either side of each arm.

Astrotoma Lyman (non Koehler).

As I have referred Koehler's three species, which he placed in Astrotoma, to Astrothamnus, Astrotoma, restr., now includes *A. agassizi* Lyman, *A. murrayi* Lyman, *A. sobrina* Matsumoto, and *A. waitei* Benham, the first being the genotype.

Astrotoma sobrina Matsumoto.

1912, Dobuts. Z. Tokyo, **24**, p. 199 (in Japanese).
Astrotoma murrayi Döderlein (non Lyman, 1879), Abh. Math.-Phys. Kl. K. Bayer. Akad. Wiss., Suppl.-Bd. I, 1911, p. 23, fig. 1, Pl. VI, figs. 1 and 1*a*, Pl. VII, figs. 14–14*b*.

Though the present Japanese form was identified as *A. murrayi* by Döderlein, I have failed to find any specimen from Japan that strictly corresponds to Lyman's description and figures of the Moluccan species, so that I am obliged to look upon the Japanese form as distinct from *A. murrayi*. It differs from that species in the much shorter arms, in the narrower brachial lobes of the disk (narrower outwards than inwards), in the longer genital slits, in the fewer and larger stumpy tubercles in the spaces just proximal to the ventral interbrachial areas, and in the comparatively fewer arm spines. The type specimen measures 34 mm. across disk and 200 mm. in arm length, while *A. murrayi* is described as 29 mm. across the disk and 280 mm. in arm length. The brachial lobes of the disk are not so wide as in *A. murrayi*, and are narrower outwards than inwards, instead of the reverse. The genital slits extend from the inner corners of the ventral interbrachial areas nearly to the disk margin. The spaces just proximal to the ventral interbrachial areas are beset with a few large stumpy tubercles, instead of numerous small ones. First tentacle pore free of arm spines; second with one or two; third, two or three; fourth, three or four; and succeeding, four, or sometimes three. In *A. murrayi*, four or sometimes five arm spines are present at each tentacle pore, even on the very basal arm joints. However, *A. sobrina* is very close to *A. murrayi*, the covering of the disk and arms being quite similar in the two species. But I consider that this similarity is generic rather than specific, as I have observed that the arm covering of the genotype, *A. agassizi*, is also precisely similar to that of the present species.

Five specimens; Sagami Sea.

Order ii. LÆMOPHIURIDA nov.

Radial shield and genital plate articulate with each other by means of a transverse ridge or a simple facet on either plate, without

well-developed articular condyles and sockets. Peristomal plates large, usually entire. Oral frames entire, without well-developed lateral wings. Dorsal arm plates often very small, while the lateral arm plates are very well developed, those of opposite sides usually meeting both above and below.

Key to families of Læmophiurida.

A—Disk and arms delicate and slender; disk scales or plates, as well as arm plates, not very stout, genital plate and scale of either side of a radius articulate with each other, instead of being soldered together; vertebræ not very stout, distal ones often incompletely divided longitudinally by a series of pores........OPHIACANTHIDÆ.

AA—Disk and arms very heavy; disk and arm plates very stout; genital plate and scale of either side of a radius, firmly soldered together; vertebræ very stout........HEMIEURYALIDÆ.

Family 1. **OPHIACANTHIDÆ** (Perrier, 1891) Verrill, 1899.

(Characters as given above in key.)

This family includes *Ophiotholia*, *Ophiomyces*, *Ophiologimus*, *Ophiophrura*, *Ophiotoma*, *Ophioblenna*, *Ophiocymbium*, *Ophiopora*, *Ophiotrema*, *Ophiomedea*, *Ophiopristis*, *Ophiolimna*, *Microphiura*, *Ophiomitrella*, *Ophioscalus*, *Ophiocopa*, *Ophiacantha*, *Ophiacanthella*, *Ophiolebes*, *Ophiochondrella*, *Ophiothamnus*, *Ophiomytis*, *Ophioplinthaca*, *Ophiomitra*, *Ophiocamax*, etc.

Ophiacantha bisquamata sp. nov.

Diameter of disk 6 mm. Length of arms 34 mm. Width of arms at base 1.5 mm. Disk pentagonal, with nearly straight or slightly convex interbrachial borders, closely covered with fine [redacted]

or less stout, obtuse. Arms composed of rather short and wide joints, uniformly tapered. Dorsal arm plates rhomboidal, with very obtuse inner angle, wider than long, with a more or less distinct median keel, so that the dorsal side of the arm is keeled as a whole. Lateral arm plates with prominent spine ridges, meeting neither above or below. First ventral arm plate very small, quadrangular, with concave inner side, longer than wide; those following, moderately large, pentagonal, with convex, but slightly notched, outer side and rounded outer angles, nearly as long as wide. Six arm spines long, flattened, more or less curved, truncate, translucent, not serrate; uppermost or upper second spine longest, about twice and a half as long as corresponding arm joint; lowest one, shortest, slightly longer than arm joint. Two oval, thin, leaf-like tentacle scales to each pore. Color in alcohol: disk grayish brown, with or without white patches on dorsal side at insertion of arm bases; arms banded with grayish brown and white. The grayish brown and white in alcohol correspond, in life, to dark green and vivid red, respectively.

Two specimens: off Ôshima, Sagami Sea; 75–85 fathoms.

Ophiothamnus venustus sp. nov.

This species is very near *Ophiomitra habrotata* H. L. Clark, but I have some doubt as to the identity of the two species, since certain differences are observable between them as now known. The present species has fine, acute, scattered spines on the disk, without any of the large, conspicuous spines, characteristic of *O. habrotata*. The arm spines of the present species are eight to ten in number to each lateral arm plate on free basal arm joints.

Numerous specimens; off Inatori, Izu, Sagami Bay.

The internal structure of the present species is quite similar to those of the genotype, *O. vicarius* Lyman, the peristomal plates being triple, the genital plates situated above the basal vertebræ, the genital scales absent and the generative glands lined by an unfolded membrane, which contains fine scales, as seen under a microscope.

The species referred to *Ophiothamnus* by modern systematists are of a type not considered *Ophiothamnus* by Lyman, while certain species, which are quite congeneric with Lyman's type of the present genus, have been referred to other genera. For examples, *Ophioleda minima* and *Ophioplinthaca occlusa* of Koehler, and *Ophiomitra habrotata* H. L. Clark, are, in my opinion, genuine *Ophiothamnus*, while *Ophiomitra exigua* Lyman (referred to *Ophiothamnus* by

Verrill), *Ophiomitra dicycla* H. L. Clark, *Ophiothamnus lævis* Lütken and Mortensen, and *Ophiothamnus stultus* Koehler are not genuine *Ophiothamnus*, but belong to a distinct type, which awaits a name, being more or less related to *Ophiomytis* and *Ophioplinthaca*.

Ophiolebes tuberosus sp. nov.

Diameter of disk 10 mm. Length of arms 38 mm. Width of arms at base 1.5 mm. Disk five-lobed, with strongly concave interbrachial borders, deeply hollowed at the central region, covered by a thick, cereous skin, which contains well-spaced, thick, rounded scales of various sizes; beset with several short, conical, stout, obtuse tubercles, which are larger and more numerous on the radial shields. Radial shields also covered by the skin, long, narrow, bar-like, strongly raised, about two-thirds as long as the disk radius. Ventral interbrachial areas covered by a skin similar to that of the dorsal side, the scales and tubercles being, however, smaller. Genital slits large, long, but not reaching disk margin. Oral shields small, thick, rhomboidal, wider than long, with wide, rounded outer angle and convex surface. Adoral shields large, quadrangular, with perfectly rounded outer angles and strongly convex surface, wider without than within, meeting each other. Between each pair of oral plates occurs a more or less distinct buccal pore. Three, or sometimes four, oral papillæ on either side, conical and blunt; inner ones smaller; outermost papilla, very large and stout. Oral papillæ project laterally beyond radial axis, and those on opposite sides of each oral slit are placed alternately. Teeth conical, stout, obtuse.

Arms slender, covered by a thin, cereous skin. Dorsal arm plates two to each joint; proximal plate small, quadrangular, wider than long, with a convex surface; on distal part of arm it becomes longer

the surface is so convex that they appear like hemispherical tubercles. Arm spines five in number on proximal joints, but four distally; they are conical, blunt, solid, terete; dorsal ones longer and stouter; uppermost about one and a half times, and lowest about two-thirds, as long as corresponding arm joint. Tentacle scales absent. Color in alcohol: yellowish brown.

Numerous specimens; Okinosé (a submarine bank), Sagami Sea.

In younger specimens, the skin, which covers the disk and arms, is very thick and the buccal pores are often indistinct.

Family 2. HEMIEURYALIDÆ Verrill, 1899 (emend.).

(Characters as given in key, p. 62.)

Key to subfamilies of Hemieuryalidæ.

A—Dorsal arm plates entire, without supplementary plates; lateral arm plates usually in contact above and below; five to eight arm spines, moderately long, conical; no proper tentacle scales, but lowest arm spine may serve as one, OPHIOCHONDRINÆ.

AA—Dorsal arm plates often accompanied by secondary plates or replaced by a mosaic of small plates; lateral arm plates usually separated above and below; three arm spines and one tentacle scale, all very short and flat .... HEMIEURYALINÆ.

Subfamily 1. OPHIOCHONDRINÆ Verrill, 1899 (emend.).

(Characters as given above in key.)

This subfamily includes *Ophiochondrus*, *Ophiomœris* and *Ophiogyptis*.

Ophiomœris projecta sp. nov.

This species closely resembles *Ophioceramis ? obstricta* Lyman (= *Ophiomœris obstricta* Koehler, 1904 = *Ophiurases obstrictus* Clark, 1911), but differs in two important points. The radial shields are distinctly joined in pairs distally for half their length. A number of large, prominent, spherical tubercles are present on the disk, irregularly arranged along the distal margin of the radial plates, along the joining line of each pair of radial shields, and often also along the outer borders of the same. In the last character, the present species reminds us of *Ophiogyptis nodosa*. The type specimen measures 4 mm. across the disk, 13 mm. in the arm length and 1.5 mm. in the arm width at base. Color in alcohol: disk gray, arms banded with grayish brown and white.

Two specimens; off Ukishima, Uraga Channel; 300 fathoms. One specimen; off Ujishima, Ôsumi.

Subfamily 2. HEMIEURYALINÆ nov.

(Characters as given in key, p. 65.)

This subfamily includes *Sigsbeia*, *Ophioplus*[2] and *Hemieuryale*.

Order iii. GNATHOPHIURIDA nov.

Radial shield and genital plate articulate by means of a conspicuous socket in the former and of a large, ball-like condyle on the latter. Genital plates, as a rule, firmly fixed to the basal vertebræ. Genital scales short, very wide, flattened, leaf-like. On abradial side of innermost part of each genital slit occurs another short, wide, flattened, leaf-like scale, which is firmly attached to oral shield. Peristomal plates small, or rarely large, usually entire, but sometimes double. Oral frames, as a rule, with well-developed lateral wings.

Key to families of Gnathophiurida.

A—Teeth triangular, with pointed ends, not very stout; oral papillæ present; dental papillæ wanting; peristomal plates large, entire; oral frames without well-developed lateral wings; genital scales, short, leaf-like; genital plates free, not fixed to basal vertebræ; distal vertebræ often incompletely divided longitudinally by a series of pores .... AMPHILEPIDIDÆ.

AA—Teeth quadrangular, with wide ends, very stout; peristomal plates small; oral frames very stout with well-developed lateral wings; genital plates firmly fixed to basal vertebræ.

a—Oral papillæ present; no vertical clump of dental papillæ; dorsal side of vertebræ rhomboidal, not U-shaped, AMPHIURIDÆ.

aa—Oral papillæ absent; dental papillæ well developed, forming a vertical clump at apex of each jaw; dorsal side of vertebræ U-shaped .... OPHIOTRICHIDÆ.

triangular, with pointed ends; dental papillæ absent. Peristomal plates large, entire. Oral frames long and slender in internal view, without well-developed lateral wings. Vertebræ of distal arm joints often incompletely divided by a series of pores. Arm spines few. Tentacle scales present, one or two to each pore.

This genus includes *Amphiura canescens*, *duplicata*, and *patula* of Lyman; *Amphiura partita*, *Ophiactis dissidens* and *O. parata* of Koehler, besides the genotype, *Amphiactis umbonata* sp. nov.

Certain representatives of the present genus were referred to *Amphiura* by Lyman, and then to *Ophiactis* by Lütken and Mortensen. *Amphiactis* differs from *Amphiura* and its allies in the absence of paired infradental papillæ, and from *Ophiactis* in the more numerous papillæ, which are arranged in a continuous series so as to close the oral slits. Further, the contrast of the present genus and the *Amphiuridæ* in many internal structures is decidedly striking. *Amphiactis* much resembles *Ophiochytra*, especially *O. tenuis* Lyman, but differs from it in the well-developed radial shields.

Amphiactis umbonata sp. nov.

Diameter of disk 7 mm. Length of arms 30 mm. Width of arms at base 1.2 mm. Disk circular, flat, covered with rather coarse, irregular scales, among which the primaries are distinct. Central plate large, circular, encircled by ten small scales, which correspond to infrabasals and basals in position. Radial plates large, larger than central plate, with strongly curved outer border, which almost forms a semicircle. The central and radial plates have each a small but distinct central boss. The second radials and the first to third interradials may also be distinguished, being larger than the secondary scales, which are irregular in size and in arrangement. Thus, the disk squamation is rather similar to that of Ophiozona. Radial shields comparatively small, oblong ovate, about two-fifths as long as disk radius, twice as long as wide, wider without than within, more convex abradially than adradially, separated by a row of three or four plates, of which the inner ones are larger than the outer. In each interradial area there are five to seven irregularly radiating rows of scales. Ventral interbrachial areas covered with more or less coarse, irregular scales. Genital slits long, nearly reaching disk margin. Genital scales invisible in external view.

Oral shields small, rhomboidal, with acute inner angle, lateral and outer angles rounded, inner sides slightly concave. Adoral shields quadrangular, wider without than within, nearly or quite meeting within. Four oral papillæ on either side, inner ones smaller

and more acute. Deep in oral slits, on either side of each jaw, occurs an additional papilla, which is conical and acute. Five teeth, all obtuse, except uppermost, which is acute.

Arms slender, flattened, uniformly tapering distally. Dorsal arm plates large, fan-shaped, twice as wide as long; inner sides slightly convex, forming an obtuse angle within; distal margin decidedly convex; outer angles rounded; successive plates separated by lateral arm plates, except the basal two or three, which are in contact with each other. Lateral arm plates low, not very prominent. First ventral arm plate small, divided into two secondary plates, of which the inner one is triangular and the outer quadrangular; those following, large, hexagonal (except second, which is pentagonal), much wider than long, widest at outer lateral angles, with concave lateral sides, distal and proximal margins slightly convex; swollen along the outer margins and especially distally, so that arm appears keeled along ventral median line. Arm spines three, subequal, about as long as corresponding arm joint (uppermost slightly longer), cylindrical, tapered and blunt. Two flat, oval tentacle scales to each pore, but sometimes three on the first. Color in alcohol: white.

Two specimens; Sagami Sea.

The internal structures of the present species are essentially similar to those of *Amphilepis norvegica* Ljungman. The peristomal plates are simple, very large. The oral frames are entire, without lateral wings. The oral plates in internal view are very slender and long. The dental plates are absent, so that the teeth arise directly from the oral plates. The genital plates are free from, instead of being fixed to, the basal vertebræ. The genital plate and radial

Subfamily 1. OPHIACTININÆ nov.

(Characters as given above in key).

This subfamily includes *Ophiactis*, *Hemipholis*,[3] *Ophiopus* and *Ophiopholis*.

Subfamily 2. AMPHIURINÆ.

(Characters as given above in key.)

This subfamily includes *Amphioplus*, *Amphilimna*, *Amphiodia*, *Ophiophragmus*, *Ophiocnida*, *Amphipholis*, *Ophiostigma*, *Amphiura*,[4] *Ophionema*, *Paramphiura*, *Ctenamphiura*, *Ophiocentrus*,[5] etc.

The first two genera may be grouped as an *Amphioplus*-group, the next three as an *Amphiodia*-group, the following two as an *Amphipholis*-group, and the last five as an *Amphiura*-group. The *Amphipholis*-group are very easily distinguished, while the other three groups are less so. These groups may be distinguished as follows:

Three classes of oral papillæ may be recognized: the first arising from the adoral shields, the second from the oral plates, and the third from the dental plates and being infradental in position. A papilla, which arises partially from the adoral shield and partially from the oral plate, is referred to the second class. Now, let +I indicate the presence of papillæ of the first class, −I the absence of same; +II the presence of papillæ of the second class, etc. Then, the groups of genera are formulized as follows:

Amphioplus-group = +I +II +III.
Amphiodia-group = −I +II +III.
Amphipholis-group = −I +II +III.
Amphiura-group = +I ±II +III.

It may clearly be seen that the *Amphiodia*-group are not intermediate between *Amphioplus*- and *Amphiura*-group, but are, say, the *Amphioplus*-group without the papillæ of the first class, while the *Amphiura*-group are the *Amphioplus*-group without all or most of the papillæ of the second class. I believe that certain species having two distal papillæ, usually referred to *Amphiodia*, are really referable to *Amphiura*.

Applying the same principle to the Ophiactininæ and Ophiotrichidæ, we have the following formulæ:

[3] *Hemipholis microdiscus* Duncan, 1870, is evidently a genuine *Amphiura*.
[4] Including *Ophionephthys*.
[5] Including *Amphiocnida*.

Ophionema = −I −II −III.
Ophiophalia = −I −II −III.
Ophiostrophida = −I −II −III.

Ophiophragmus japonicus sp. nov.

Diameter of disk 7 mm. Length of arms 45 mm. Width of arms at base 1 mm. Disk five-lobed, with very convex interbrachial borders, covered with fine, imbricating scales, among which the six primaries are more or less distinguishable. Radial shields semilunar, one-third as long as disk radius, twice as long as wide, joined in pairs, being, however, separated only at proximal end, which is obtusely pointed. A row of large and squarish scales borders disk. Scales of ventral interbrachial areas just outside the marginal series turned up, so as to form the sort of fence characteristic of genus. Marginal scales more elevated than arms; ventral interbrachial areas strongly convex below. Genital slits long.

Oral shields rhomboidal, with inner sides much longer than outer, inner angle very acute, outer and lateral angles rounded; much longer than wide. Adoral shields triangular, tapered within to a point, not meeting each other. Four oral papillæ on either side of each jaw, close-set, unequal, blunt, innermost somewhat stouter.

Dorsal arm plates elliptical, large, outer border curved, inner border strongly convex, forming part of a circle; as wide as arms, twice as wide as long, slightly in contact with each other. Lateral arm plates inserted like so many wedges between successive dorsal arm plates above and ventral plates below; well separated above and nearly so below. First ventral arm plate very small, quadrangular, much wider than long; those beyond pentagonal, with very large

Amphipholis japonica sp. nov.

This species is extremely near *A. squamata*, being distinguished from it merely by certain trifling differences. I have compared the Japanese material with specimens of *A. squamata* from Naples. In Neapolitan specimens the arms are two and a half to three times as long as the disk diameter, while in Japanese specimens they are three to four times as long as the same. The distal margin of the ventral arm plates of Neapolitan specimens is nearly straight, while that of Japanese specimens is considerably convex. In the last character the present species resembles *A. australiana* H. L. Clark, differing, however, from that species in the more numerous disk scales of the dorsal side and in the coarser disk scales of the ventral side. The radial shields have each a white spot at the outer end, quite as in *A. squamata*.

Like *A. squamata*, the present species is viviparous. In summer, the larger individuals contain several embryos. I once dissected out six embryos from an adult. Animals containing full-grown embryos appear to give birth to them the night after they are placed in an aquarium.

This species is common in the neighborhood of Misaki, and is found living under stones on fine sand. As to the sensibility of this species to the coarseness of sand, the following observations were made at Arai Beach, Misaki Marine Biological Station. In the summer of 1910, the beach was at first abundantly supplied with small areas among rocks covered with fine sand, and this ophiuran was found very abundantly; after a heavy storm, very few individuals were found, owing to the fact that the spots with fine sand were mostly wiped out. In the summer of 1911, the spots with fine sand were very few, and this ophiuran was seldom found. In the summer of 1912, the beach was entirely covered with coarse sand, and I could no more find this ophiuran. It is a very active species, quickly concealing itself in the sand when the stone is turned up.

Amphiura vadicola[6] sp. nov.

? *Ophionephthys phalerata* Marktanner-Turneretscher (non Lyman, 1874), Ann. K. K. Naturhist. Hofmus., II, 1887, p. 301.

Diameter of disk 8 mm. Length of arms 260 mm. Width of arms at base 1 mm; at the widest part 1.3 mm. Disk five-lobed, with indented interbrachial borders, covered by a soft, naked skin, except along inner and abradial borders of radial shields, where

[6] The interesting life habits of this ophiuran were described by the late Prof. Mitsukuri and Prof. Hara: The Ophiurian Shoal, *Annot. Zool. Jap.*, I, 1897, p. 68.

there are several rows of fine, imbricating scales. Radial shields large, long, pear-seed-shaped; naked part two-thirds to one-half as long as disk radius and about thrice as long as wide. Genital slits long. Genital scales not very conspicuous unless the specimen is dried, arranged in a row and overlapping one another.

Oral shields small, pentagonal, with rounded angles, outer sides longest, inner side slightly concave; madreporic shield much larger than the rest, almost circular. Adoral shields small, triangular, with concave adradial side, meeting neither radially or interradially. Oral plates long and very narrow. There is a more or less conspicuous buccal pore between each pair of oral plates, as in *Ophiothrix*. Two oral papillæ on either side of each jaw, conical, blunt, very stout; the distal one arises from the adoral shield and is longer than the apical one, which arises from the dental plate. Teeth very stout, truncate.

Arms exceedingly long, more than thirty times as long as disk diameter; they are widest at about one-third their entire length from base. Dorsal arm plates almost oval, bounded within by two nearly straight lines, forming a very large and obtuse angle, and without by a curve, which is nearly flat towards median line, but very strong laterally; about twice as wide as long, successive plates slightly in contact with each other. On basal arm joints, they are very small and separated by spaces, which are covered by a naked skin. Lateral arm plates not very prominent, almost covered by arm spines, not meeting above or below, nor in contact on sides, but separated by naked spaces. First ventral arm plate very small, quadrangular, wider than long; those beyond, quadrangular, wider than long, except basal one or two, which are as long as, or longer

Numerous specimens; Sakurajima, Kagoshima Gulf.

This species is very near *Ophionephthys phalerata* Lyman, but differs from it in the much larger radial shields, in the not oval but pentagonal oral shields, in the adoral shields, which are not in contact with each other, in the longer oral plates, in the dorsal arm plates being in contact with each other, in the ventral arm plates being separated from each other and not very wide on the basal joints, and in the not cylindrical, but flattened, thorny arm spines.

Amphiura æstuarii sp. nov.

Diameter of disk, 6 mm. Length of arms, 75 mm. Width of arms at base, 0.8 mm. Disk five-lobed, with concave interbrachial borders, covered by a soft, naked skin, except along inner and abradial borders of radial shields, where it is covered by fine, imbricating scales, arranged in four or five rows on inner border, but in only one on outer part of abradial border. Naked part of radial shields large, pear-seed-shaped, more than half as long as disk radius, more than twice as long as wide, hardly in contact without, slightly divergent within. Genital slits long. Genital scales not very distinct.

Oral shields rhomboidal, or pentagonal with a very short inner side, outer angle much rounded; wider than long. Madreporic shield much larger and almost circular. Adoral shields triangular, with concave inner side, tapered within, where they do not meet. Two pairs of oral papillæ to each jaw; apical ones oval and very stout; distal ones conical, obtuse, arising from adoral shields. Teeth stout, truncate.

Dorsal arm plates transversely elliptical, twice as wide as long, successive plates in contact with each other. Lateral arm plates not very prominent, almost covered by arm spines, not meeting above or below, not in contact on sides, but separated by naked spaces. First ventral arm plate very small, pentagonal or quadrangular, wider within than without; those beyond, quadrangular, with convex inner side, notched distal margin, and rounded distal angles; wider than long, except basal one or two; not in contact, but separated by a narrow space, where ventral ends of lateral arm plates are wedged in. Arm spines five, on basal joints, but four in middle part of arm, subequal or lower slightly longer, nearly equal to, or a little longer than, corresponding arm joint; conical and obtuse on proximal joints, but flattened distally; next to lowest spine especially flattened and rather spur-shaped, with numerous thorns on its much flattened tip; lowest spine (as well as second above it) also more or less thorny at tip.

Tentacle pores large, without scales. Color in alcohol: disk gray; radial shields and arms straw-yellow.

Numerous specimens; Aburatsubo Cove: Misaki Marine Biological Station.

A. æstuarii differs from the foregoing species, *A. vadicola*, in the shape of the radial shields, in the much shorter arms, in the dorsal arm plates, which are very wide even on the basal joints, and in the fewer, less flattened arm spines.

A. æstuarii together with *A. euopla* H. L. Clark are easily obtained by dredging in the muddy bottom of Aburatsubo Cove. They probably live buried in mud, as *A. vadicola* does in sand, and I believe that, the reduced disk scales and the numerous thorny arm spines are correlated with the mode of life.

Family 3. OPHIOTRICHIDÆ Ljungman, 1867.

(Characters as given in key, p. 66.)

This family includes *Ophiothrix*, *Ophiopteron*, *Ophiocampsis*, *Ophiophthirius*, *Ophiotrichoides*, *Ophiomaza*, *Ophiocnemis*, *Ophiothela*, *Ophiopsammium*, *Ophiogymna*, *Lutkenia*, *Gymnolophus*, *Ophiolophus*, *Ophioœthiops* and *Ophiosphæra*.

Order iv. CHILOPHIURIDA nov.

Radial shield and genital plate articulate with each other by means of two condyles and one pit on either plate. Genital plates and scales bar-like. Peristomal plates small, or sometimes moderately large, usually double or triple. Oral frames with or without well-developed lateral wings. Oral papillæ very well developed, close set, the outermost one usually pointing inwards and stretching above the next papilla, which is the largest as a rule.

d—Disk closely covered with granules; arms stout, stoutest at base; numerous arm spines, OPHIODERMATIDÆ, pars.
dd—Disk usually free of granules; arms slender, stoutest at a distance from base ......OPHIOCHITONIDÆ.
cc—Dental papillæ well developed, forming a vertical clump at apex of each jaw; disk often covered with granules; arms stout, stoutest at a distance from base, OPHIOCOMIDÆ.

Key to families of Chilophiurida (II).

A—Teeth not very stout, usually triangular; oral frames entire, without well-developed lateral wings.
a—Second oral tentacle pores open more or less, or entirely, outside oral slits............OPHIOLEPIDIDÆ, pars.
aa—Second oral tentacle pores open within oral slits.
b—Disk squamated or tessellated, free of granules.
c—Arms stout, stoutest at base; arm spines short, appressed............OPHIOLEPIDIDÆ, pars.
cc—Arms slender, stoutest at a distance from base; arm spines long, not appressed....OPHIOCHITONIDÆ, pars.
bb—Disk covered with granules.
d—Arms slender, stoutest at a distance from base; arm spines few.
e—Arms inserted ventrally to disk; arm spines appressed............OPHIOLEUCIDÆ.
ee—Arms inserted laterally to disk; arm spines not appressed............OPHIOCHITONIDÆ, pars.
dd—Arms stout, stoutest at base; numerous arm spines............OPHIODERMATIDÆ.
AA—Teeth very stout, quadrangular; oral frames with well-develloped lateral wings.
f—No vertical clump of dental papillæ.
g—Arms stout, stoutest at base; arm spines short, appressed OPHIOLEPIDIDÆ, pars.
gg—Arms slender, stoutest at a distance from base; arm spines long, not appressed.... OPHIOCHITONIDÆ, pars.
ff—Dental papillæ well developed, forming a vertical clump at apex of each jaw, OPHIOCOMIDÆ.

Family 1. OPHIOLEPIDIDÆ Ljungman.

(Characters as given above in keys.)

Key to subfamilies of Ophiolepididæ.

A—Second oral tentacle pores open more or less, or entirely, outside oral slits............OPHIOMASTINÆ.
AA—Second oral tentacle pores open entirely within oral slits, OPHIOLEPIDINÆ.

Subfamily 1. OPHIOMASTINÆ nov.

(Characters as given in key p. 75.)

This subfamily includes *Ophiomastus*, *Ophiotypa*, *Ophiomisidium*, *Ophiophycis*, *Anthophiura*, *Ophiopyrgus*, *Ophiochrysis*, *Ophiosteira*, *Gymnophiura*, *Ophiura*, *Ophionotus*, *Ophioperla*, *Ophiotjalfa*, *Ophiogona*, *Ophioplinthus*, *Ophiopleura*, *Ophiocten* and provisionally *Astrophiura*, besides five new genera, *Haplophiura*, *Aspidophiura*, *Amphiophiura*, *Stegophiura* and *Ophiurolepis*.

Koehler's recently described genus *Ophiomisidium* includes *Ophiomusium pulchellum* Wyville Thomson, *O. flabellum* Lyman, and *O. speciosum* Koehler, the last being the genotype. The group evidently stands between *Ophiomastus* and *Ophiophycis* in systematic position.

HAPLOPHIURA gen. nov.

Disk high, much elevated above arms, covered above with plates and scales, among which the primaries are very prominent, and below with close-set, fine granules. Radial shields stout, joined in pairs. Oral papillæ soldered together. Genital plates and scales present, but invisible in external view. Genital bursæ absent and genital slits invisible. Arms short, low, wider than high, covered with convex arm plates. Tentacle pores, including second oral ones, which open entirely outside oral slits, naked, being free from scales. Arm spines few, minute.

This new genus contains only a single species, *Ophiozona gymnopora* H. L. Clark.

ASPIDOPHIURA gen. nov.

Disk rather high, elevated above arms, flat, covered with very

Aspidophiura watasei sp. nov. It stands rather between *Anthophiura* and a certain group of *Amphiophiura* with very conspicuous ventral interbrachial plates.

Aspidophiura watasei sp. nov.

This species is very near *A. forbesi*, but differs from it chiefly in the presence of a central boss to each of the six primary plates, in the smaller radial shields, which are about as large as the radial plates, in the ventral arm plates, which more rapidly diminish in size outwards, in the longer arm spines, which are longer than half the corresponding arm joint, and in the absence of tentacle scales beyond the disk.

The present species differs from *A. minuta* chiefly in the presence of a central boss to each of the six primaries, in the smaller radial shields and in the better-developed arm combs.

The type specimen is 5 mm. across the disk with arms probably about twice the disk diameter, and 1.3 mm. in width. Color in alcohol: disk yellowish gray above and white below; arms white.

One specimen; Sagami Sea. One specimen; Uraga Channel.

AMPHIOPHIURA gen. nov.

Disk high, often convex, covered with plates and scales, among which the primaries are very prominent. Radial shields stout, joined in pairs. Arm combs and genital papillæ present. Oral shields oval, pyriform or trefoil. Second oral tentacle pores open more or less, or entirely, outside oral slits; large, guarded by numerous scales. Arms moderately long, gradually tapering outwards, with blunt tips. Dorsal and ventral arm plates fairly well developed; successive plates in contact with each other at least on proximal arm joints. Lateral arm plates high, with few to numerous short, peg-like arm spines. Tentacle pores large, with numerous scales.

This new genus includes *Ophioglypha bullata* Wyville Thomson, which is here designated as the genotype; also the following species with very conspicuous oral shields, which almost cover the ventral interbrachial areas, *O. convexa* Lyman and *O. insolita*, *improba*, and *abdita*, of Koehler; also the following species with very conspicuous ventral interbrachial plates, *O. solida* and *scutata* of Lyman, *O. stellata* Studer, *O. paupera*, *sordida*, *liberata*, *urbana*, *remota*, and *latro* of Koehler, and *Ophiura œdiplax* and *pompophora* of H. L. Clark; also the following species with the ventral interbrachial areas covered with many scales and having quadrangular ventral arm plates, *Ophioglypha sculptilis* (= *O. variabilis*) *lacazei*, *lapidaria*,

outwards, the plates are longer than wide, hexagonal, with very short proximal and proximo-lateral sides, concave lateral margins and a very convex distal side. Arm spines seven or eight, including the tentacle scales, on the free basal joints, fine, conical, short; middle ones longer than upper and lower ones, and about half as long as corresponding arm joint; diminishing in number outwards; the lower spines are much finer and serve as tentacle scales. Second oral tentacle pore, very large, opening outside oral slit, bounded by three or four scales on each side. Tentacle pores large, guarded on basal joints by one to three aboral scales, besides the lower arm spines on the adoral side. Color in alcohol: pale gray.

Numerous specimens; Sagami Sea. Numerous specimens; Sagami Sea, 75 and 100 fathoms.

This species is viviparous. I once dissected out twenty-four embryos of various sizes from a single adult.

OPHIUROLEPIS gen. nov.

Disk covered with larger rounded plates and smaller scales, the former surrounded by belts of the latter. Radial shields moderately large, rounded, separated from each other. Adoral shields oval, with rounded inner border and obtusely pointed outer end. One to three supplementary plates are present in each space between the adoral shields and oral plates. Teeth and oral papillæ present, the latter very close set. Arm combs, as well as genital papillæ, absent. Arms long, stout, very gradually tapered. Dorsal arm plates very well developed, widely in contact with each other. Lateral arm plates low. Ventral arm plates triangular, nearly or scarcely in contact with each other. Second oral tentacle pores open entirely outside oral slits, long, slit-like, closed by tentacle scales, which

separated from each other, sometimes more or less joined in pairs. Second oral tentacle pores open nearly or entirely outside oral slits, very large, beset with numerous scales. Genital papillæ, and usually also arm combs, present. Arms low, often flattened. Dorsal arm plates usually well developed and in contact with each other. Lateral arm plates low, those of the two sides being in contact with each other below. Three or more arm spines of variable length. Tentacle pores of one or two innermost pairs large and beset with rather numerous scales, but those beyond very small and beset with a few scales.

This genus, as here restricted, includes *Asterias ciliata* Retzius and the following species with spiniform genital and comb-papillæ: *Ophiura albida* Forbes, *Ophiolepis robusta* Ayres, *Ophiura sarsii, arctica, carnea,* and *affinis* of Lütken, *O. kinbergi* Ljungman, *O. hexactis* and *brevispina* of Smith, *O. acervata, inermis, papillata, flagellata* (= *Gymnophiura cærulescens* Lütken and Mortensen), *imbecillis, lepida, æqualis, ljungmani,* and *meridionalis* of Lyman, *O. aurantiaca* Verrill, *O. maculata* Ludwig, *O. amphitrites* Bell, *O. indica* Brock, *O. thouleti* Koehler, *Ophiozona capensis* Bell, *Ophiura leptoctenia, micracantha, quadrispina, bathybia* and *Ophiocten oöplax* H. L. Clark; also the following species with blunt and flat genital and comb papillæ, *Ophioglypha multispina* and *lymani* Ljungman, *O. lutkeni, irrorata, undata, costata, albata, jejuna, loveni, fraterna, rugosa, inornata, confragosa, intorta, ambigua, abyssorum, tenera* and *falcifera* of Lyman, *O. verrucosa* Studer, *O. inflata, clemens, concreta, mundata* and *aspera* of Koehler, *O. plana, scutellata, nana* and *obtecta* of Lütken and Mortensen, *O. tessellata* Verrill, *Ophiura clasta, monostæcha, atacta, calyptolepis* and *cryptolepis* of H. L. Clark.

Ophionotus, Ophioperla and *Ophiotjalfa* are very close to the present genus—especially to the typical group with spiniform genital and comb papillæ and with rather long arm spines. *Ophionotus* may be defined as typical *Ophiura* with supplementary dorsal arm plates; *Ophioperla* as Ophiura with granulated disk; and *Ophiotjalfa* as Ophiura without genital papillæ and arm combs.

Subfamily 2. OPHIOLEPIDINÆ nov.

(Characters as given in key, p. 75.)

This subfamily includes *Ophiomusium, Ophiolipus, Ophiophyllum, Ophiopenia, Ophiocrates, Ophiomidas, Ophiothyreus, Ophiozona, Ophioceramis, Ophiolepis* and *Ophioplocus,* besides a new genus, *Ophiozonella,* which is separated from *Ophiozona.*

... in wide sense.

... peruliform: peris-
... nearly entire, with fairly
... median secondary
... emend.
... stretching above
... peristomal plates
... consisting of two
...
... granules: arm plates
... of distal
... arm spines
... neither of which
...
... ventral
... separated from
... nov.
... serrate end.
... than wide, dis-
... nov.
... finely striated;
... two
... overlaps
... nov.
... arm spines
... restr.
... with granules.
...
... with fine
... restr.

brevispina Ludwig. *Ophiochæta* contains only *O. hirsuta* Lütken. Genuine *Ophioconis* much resembles *Cryptopelta*, but has, however, hyaline arm spines. Genuine *Ophiochæta* appears to be very near *Pectinura*, but is, however, covered with fine spines, instead of granules, on the disk. "*Ophioconis*" *indica* Koehler, which I do not dare to name generically, as I have not myself examined it, appears to resemble *Pectinura*, except for the hyaline arm spines and the presence of a single tentacle scale on most of the tentacle pores, instead of two.

OPHIUROCONIS gen. nov.

Disk and oral angles, including oral shields, closely covered with fine granules. Six or seven oral papillæ on either side of each jaw; outermost one pointed inwards, stretching above next papilla, which is the largest. Teeth triangular and obtusely pointed. Arms not very long, cylindrical, widest at the base, tapering outwards to the very slender tip, where the vertebræ are imperfectly divided into halves by a longitudinal series of pores. Ventral arm plates wider than long, not in contact with each other, except on the most proximal joints. Arm spines six or more, more or less long, flattened, hyaline and not appressed. One or two tentacle scales to each pore.

Ophiuroconis monolepis sp. nov.

This species is at once distinguished from both *O. pulverulenta* and *miliaria* by fewer oral papillæ, by fewer and shorter arm spines and by the presence of a single tentacle scale, instead of two, to each pore. Oral papillæ, six or seven in number on either side of each jaw, close-set and acute. Each lateral arm plate bears six or seven arm spines, which are rather spiniform, acute, slightly flattened and hyaline; uppermost one or two spines nearly twice as long as, and lowest one slightly shorter than, corresponding arm joint. A single small, leaf-like, but acutely pointed, tentacle scale at each pore. Dorsal arm plates, rather small, fan-shaped, not in contact with each other, wider than long, convex along median line, so that the arm is keeled dorsally as a whole. Ventral arm plates, very small, much wider than long, much shorter than corresponding arm joint. All the dorsal, lateral and ventral arm plates are concentrically striated.

The type specimen is 5 mm. across disk, 25 mm. in arm length and 1 mm. in arm width at base. Color in alcohol: light yellow.

Six specimens; Sagami Sea, 85 fathoms. Two specimens; Sagami Sea, 300 fathoms.

OPHIURODON gen. nov.

Disk and oral angles, including oral shields, closely covered with fine granules. Four or five oral papillæ on either side of each jaw; outermost pointed inwards, stretching above next papilla. Teeth flat, thin, with widened and often serrate end. Arms not very long, widest at base, tapering outwards to the very slender tip. Ventral arm plates very narrow, longer than wide, distinctly in contact with each other. Vertebræ of distal arm joints often imperfectly divided into halves by a longitudinal series of pores. Six or more arm spines, long, flattened, hyaline, not appressed. Single tentacle scale to each pore.

The genotype is *Ophioconis grandisquama* Koehler, and it is worth noting that a specimen of this species was recently collected at Okinosé (a submarine bank), in the Sagami Sea.

OPHIUROCHÆTA gen. nov.

Disk closely covered with fine granules and sparsely beset with fine spines. Oral angles also granulated, but oral shields naked. Numerous close-set oral papillæ, of which outermost one is pointed inwards, stretching above next papilla, which is the largest. Teeth triangular and obtusely pointed. Arms not very long, rather stout, stoutest at base. Dorsal, as well as ventral, arm plates well developed, widely in contact with each other. Six or more arm spines, long, flagellate, opaque, not appressed. Two tentacle scales to each pore, abradial one overlapping base of lowest arm spine.

The genotype is *Ophiochæta mixta* Lyman.

Ophiurochæta differs from *Ophiolimna* in the following important particulars: more numerous oral papillæ, of which the outermost

entire, or double with soldered halves, and always lack a third, median secondary plate. Further, the peristomal plates of the former type are distinctly longer in proportion to their width than are those of the latter.

Ignoring the smaller size, *Ophiurochæta* much resembles *Ophiarachna*, the only essential differences being the presence of scattered disk spines and the absence of accessory oral shields. The systematic value of the accessory oral shields is, however, considered insignificant by Dr. H. L. Clark. I have also observed the absence of the accessory oral shields in some interradii of a specimen of *Ophiarachna incrassata*. One may safely say, then, that the relation of *Ophiurochæta* to *Ophiarachna* is parallel to that of *Ophiomastix* to *Ophiocoma* or of *Ophiochæta* to *Pectinura*.

Subfamily 2. OPHIODERMATINÆ nov.

(Characters as given in key, p. 83.)

This subfamily includes *Ophioconis*, restr., *Cryptopella*, *Bathypectinura*, *Pectinura*, *Ophiopezella*, *Ophiochæta*, *Ophiarachnella*, *Ophiochasma*, *Ophioderma*, *Ophioncus* and *Diopederma*.

Bathypectinura gotoi sp. nov.

Diameter of disk 50 mm. Length of arms 195 mm. Width of arms at base 7 mm. Disk pentagonal, flat, closely covered with fine granules, of which four or five are contained in 1 mm. Radial shields only partly naked, but distinguishable through the superficial granulations, by the slight swelling, as large, elongated ovate plates, nearly half as long as disk radius, wider outwards; naked part very small, ovate, and wider without than within. Genital slits very long, almost reaching disk margin. Genital plates visible from exterior, lying along adradial border of slits, long, very stout.

Oral shields small, triangular, with rounded angles and convex sides, nearly as wide as long. Accessory oral shields very rudimentary; in one of the two specimens they are absent, but in the other they are indistinctly represented by one or two small scales, which are separated from the oral shield by granules. The adoral shields are almost, and the oral plates entirely, covered with granules, which are coarser and sparser than distally. Eight or nine oral papillæ on either side; outermost two or three large, flat, thin, outer second largest; inner ones small, more or less conical, obtuse. Five to seven teeth, irregular in shape and size, with pointed or rounded ends, arranged in an irregular vertical row.

Arms long, stout, gradually tapered outwards, with a rather sharp

dorsal median ridge, triangular in transverse section. Dorsal arm plates large, occupying almost entire dorsal surface of arm, quadrangular, with rounded outer corners, a little wider without than within, three to four times as wide as long, with a rather sharp ridge on the median line; some are divided into several irregular secondary plates. Lateral arm plates very low, less than half height of arm, meeting neither above nor below. Ventral arm plates small, rhomboidal, with shorter diameter parallel to arm axis. First plate almost as wide as, but much shorter than, following; the three or four plates beginning with the second have a median keel, which is more prominent proximally both with regard to each plate and to the arm as a whole. Arm spines four for the most part, but three distally, very short, flattened, lanceolate, obtuse, lowest one somewhat longer than the others, but not so long as corresponding arm joint. One tentacle scale, large, oval, thin, flat. Color in alcohol: light yellowish brown.

Two specimens; Sagami Sea, 170 fathoms.

This new species is very near *R. inornata* (Lyman), but differs from it in the coarser disk granules, in the smaller naked part of the radial shields, in the more strongly ridged dorsal arm plates, in the much lower lateral arm plates, in the wider and rhomboidal ventral arm plates, and in the shorter arm spines.

Family 4. OPHIOCHITONIDÆ nov.

(Characters as given in keys, pp. 74 and 75.)

Key to subfamilies of Ophiochitonidæ.

a.—Teeth triangular, not very stout; peristomal plates moderately

reducta Koehler (referred to *Bathypectinura* by Dr. H. L. Clark).[9] It is, however, distinguished from *O. ljungmani* by the presence of primary disk plates, by coarser disk scales, by shape of radial shields, by the disk margin being not so closely granulated, and by the shape of the oral shields; from *O. custos* by the presence of primary disk plates, by coarser disk scales, by the shape of the radial shields, by the adoral shields not meeting each other within, by the shape of the first and second ventral arm plates, by the presence of lamellar plates at the arm bases, and by shape of dorsal arm plates; and from *O. reducta* by dorsal side of disk being free of granules, by radial shields not being divergent, and by shape of ventral arm plates. Disk covered with fine, imbricating scales, among which the six primaries are more or less distinct; the radial plates are smaller and less conspicuous than the central plate. Radial shields triangular, with acute inner angles, twice as long as wide; those of a pair are nearly parallel, being separated from each other. Ventral interbrachial areas are closely covered with very fine granules. Oral shields large, triangular, with strongly curved outer border, less curved lateral sides, obtuse inner angle and perfectly rounded lateral angles. Adoral shields large, triangular, long, tapered within to an acute point, but they do not meet. Lamellar plates and fine granules occur on dorsal and lateral surface of free arm bases. Dorsal arm plates triangular at first, but soon becoming quadrangular with rounded outer corners and curved lateral borders, much wider without than within. First ventral arm plate is small, triangular, with rounded angles, nearly as wide as long; those beyond are pentagonal, with an inwardly directed angle, which is covered by the preceding plate; outer border curved, and lateral borders concave and bounded by tentacle pores. A single large, oval tentacle scale occurs on the abradial side of each pore; besides, on the adradial side of a few basal pores, there are present one or two rudimentary tentacle scales, more or less covered over by the abradial one.

The type is 4.5 mm. across the disk, 35 mm. in arm length and 0.8 mm. in arm width at base. Color in alcohol: yellowish gray above and white below; arms banded with dark gray.

One specimen; off Kôtsujima, Sagami Sea.

It is recorded that the above specimen was taken with a coral-net,

[9] *Ophiopeza reducta* appears to me to be referable to *Ophioplax*. The presence of only three long, cylindrical arm spines and of only five oral papillæ, the annulation on the arms and the naked oral plates are all characters of *Ophioplax*, but not of genuine *Bathypectinura*.

[illegible] Bull. [illegible] XXXI, [illegible]

[illegible] 69 mm. Width of [illegible] mm. Disk circular, [illegible] imbricating scales, [illegible] as though covered [illegible] short, exceedingly [illegible] each other, hard to [illegible] scales similar to [illegible] Genital slits large, [illegible]

[illegible] angle and rounded

semicircular, about one-half as large as the dorsal arm plate, and bounded along the distal border by one or two very insignificant secondary supplementary plates, which, however, are present only for a comparatively short distance near the arm base; two or three first dorsal arm plates and their supplementary plates are smaller than those beyond; supplementary plates smaller outwards as dorsal arm plates become quadrangular, and finally disappear. Lateral arm plates not very prominent, meeting neither above nor below. First ventral arm plate very small, rather pentagonal, longer than wide; those beyond, quadrangular, with rounded outer lateral angles, truncated inner lateral angles and slightly notched outer border, nearly as long as wide, but longer than wide distally. Three arm spines, short, stout, flattened, blunt. One large, oval tentacle scale to each pore. Color in alcohol: grayish yellow; disk reticulated, and arms banded, with dark purplish brown.

Three specimens; Enoshima. Numerous specimens; Arai Beach, Misaki Marine Biological Station.

The arm length varies from six to eight times the disk diameter. In smaller specimens the arm spines are less flattened; and in those smaller than 4 mm. across the disk the secondary supplementary dorsal arm plates are almost invisible.

This species differs from the genotype, *O. dictydisca* H. L. Clark, in the shape of the dorsal arm plates, in the less distinct secondary supplementary dorsal arm plates and in the smaller and more insignificant radial shields. Further, schizogonic reproduction has not been observed in the present species, though I have examined many very small specimens. *O. marktanneri*, as well as the genotype, resembles *Ophionereis dubia* in lacking the genital papillæ, but differs from it chiefly in the presence of the secondary supplementary dorsal arm plates and in the much narrower arms. *O. marktanneri* is by no means near *Ophionereis porrecta* Lyman. I could mention some more differences than those enumerated by Koehler between these two species, but it is not necessary to do so here.

This charmingly handsome species is one of the most common ophiurans about Misaki, living under stones and rocks.

Family 5. OPHIOCOMIDÆ Ljungman, 1867.

(Characters as given in keys, pp. 74 and 75.)

Key to subfamilies of Ophiocomidæ.

A—Radial shields long and wide, boot-shaped, widely separated from each other; three to five arm spines; tentacle scales short and leaf-like . . . . OPHIOCOMINÆ.

AA—Radial shields long and very narrow, bar-like, each pair approximating each other at the outer ends; numerous arm spines; two tentacle scales, of which the abradial one is minute and acute, and the adradial one is very long and lanceolate,
OPHIOPSILINÆ.

Subfamily 1. OPHIOCOMINÆ nov.

(Characters as given above in key.)

This subfamily includes *Ophiopteris*, *Ophiocoma*, *Ophiomastix* and *Ophiarthrum*.

Subfamily 2. OPHIOPSILINÆ nov.

(Characters as given above in key.)

This subfamily is formed by a single genus, *Ophiopsila*.

Though *Ophiopsila* is referred to the Amphiuridæ by certain authors, it fundamentally differs from the latter in the internal structures. The oral frames have well-developed lateral wings, as in the Amphiuridæ, Ophiotrichidæ, *Ophioceramis*, Ophionereidinæ and Ophiocominæ. The oral and dental plates are π-shaped (instead of being x-shaped) in common outline in internal view, quite as in *Ophioceramis*, the Ophionereidinæ and Ophiocominæ. The genital plates are entirely free from the basal vertebræ and have two condyles and one pit at the outer end to match two condyles and one pit of the radial shield, as an important characteristic of the Chilophiurida; while those of the Amphiuridæ and Ophiotrichidæ are firmly fixed to the basal vertebræ and have only a single large condyle to match one large socket of the radial shield. The genital scales are long, narrow and bar-like, also a characteristic of the Chilophiurida; while those of the Gnathophiurida are short, very flat and leaf-like. As to the external characters, the presence of both oral and well-

MARCH 16.

MR. CHARLES MORRIS in the Chair.

Forty-seven persons present.

The Publication Committee reported the reception of papers under the following titles:

"Fixation of single type (Lectotypic) specimens of species of American Orthoptera. Division III." By Albert P. Morse and Morgan Hebard (February 27).

"Notes on hematognathus fishes." By Henry W. Fowler (March 1).

"Cold-blooded vertebrates from Florida, the West Indies, Costa Rica, and Eastern Brazil." By Henry W. Fowler (March 1).

The deaths of Thomas Biddle, M.D., a member, February 19, 1915, and of James Geikie, a correspondent, March 2, 1915, were announced.

DR. CLARENCE E. MCCLUNG made a communication on parallel differences in germ cell organization and characters of the body, illustrated by representatives of groups or families of Orthoptera.

The Recording Secretary read the following communication from ADELE M. FIELDE:

A new hypothesis concerning butterflies.—It is known that a virgin female moth or butterfly of the Great Peacock, the Oak Egger, and some other species attracts males of her kind from afar.

No naturalist has written of this matter more charmingly than has Jean Henri Fabre.[1] Having sequestered such a female under a wire-gauze cover, scores of males came from woodsy distances to seek her. Putting her in an air-tight cell, whether of paper, wood, glass, metal or cotton batting prevented the escape of her effluvium and therefore prevented the arrival of her suitors. If placed under a bell glass, where she was plainly visible to the oncoming swarm of males, they ignored her and settled upon a twig, a chair-bottom, a bit of flannel, or a few dry leaves where she had reposed and affixed her subtile aroma. Even smooth, clean surfaces retained her emanation after contact with her and lured the male in her absence. Neither strong stenches made by napthaline, tobacco, or sul-

[1] Social Life in the Insect World, 1912, pp. 179–216.

[illegible] spike-[illegible] flocking of [illegible]

[illegible] the question [illegible] cannot be [illegible] None of the maimed [illegible] surgical operation. [illegible] of normal [illegible]

[illegible] that this organ [illegible] capable of [illegible] If [illegible] the same [illegible] having power [illegible] species of [illegible] the sub-nose [illegible] whose ephemeral [illegible] of the [illegible]

[illegible] would not [illegible] Surgery [illegible] the sub-nose [illegible] through abnor-[illegible] elimination of [illegible] might possess [illegible] might lack [illegible] series of sub-noses [illegible] apparently endowed [illegible]

[illegible] generally impels [illegible] natural food [illegible] mature insect does not eat the sort of food upon which the larvæ subsist and grow, and since the pupa-stage, in some cases continuing many months, inter-

fifteen inches from the surface of the ground to its subterranean sustenance, probably has a sub-nose that smells nothing save the fungus whose odor emanates from the sandy soil.

There is great significance in the fact that spiders and scorpions, having no practical use for the sense of smell in their habitual activities, have no antennæ.

Summary.—If moths and butterflies, like certain ants, have a compound nose, then one of the sub-noses guiding the habitual activities of the male insect may function exclusively in discerning the odor of the adolescent female. Elision of the whole antennæ would then prevent, as it possibly did in the case of Fabre's Oak Eggers, a return under the allurement offered by the female.

Moths and butterflies normally lacking such a sub-nose would not be subject to this particular lure, although the antennæ were intact.

This hypothesis fits the phenomena and explains what has heretofore been considered mysterious.

Jacob Parsons Schaeffer, M.D., was elected a member.

The following were ordered printed:

FIXATION OF SINGLE TYPE (LECTOTYPIC) SPECIMENS OF SPECIES OF AMERICAN ORTHOPTERA.

DIVISION III.

BY ALBERT P. MORSE AND MORGAN HEBARD.

SPECIES OF NORTH AMERICAN ORTHOPTERA DESCRIBED BY ALBERT PITTS MORSE.

The desirability of selection and fixation of a single type has been discussed and such work accomplished for a large number of species of North American Orthoptera in the first paper bearing the title here used by James A. G. Rehn and the present junior author.[1] The species of North American Orthoptera described by A. N. Caudell have been treated in similar manner in the second division of the series by their sponsor and the present junior author,[2] and in this paper the species described from North America by the present senior author, whether valid or established synonyms, are similarly treated.

It has been a rule with the senior author to consider every specimen of the series originally described as a type, but the selection from these of the single type by their author obviates all difficulties which might otherwise have arisen.

In the present paper, North America is used in its restricted sense, only including that part of the continent north of the Mexican line, as has been done in the other papers of the series, except in particular

in the original description is used throughout, as this paper is not intended to be in any way revisionary.

PARATETTIX HESPERUS.

Jour. N. Y. Ent. Soc., VII, p. 198, (1899).

Described from two hundred and seventy-six specimens of both sexes from one locality.

Single type here designated: ♀; Glendale, Oregon, September 9, 1897; Morse.

PARATETTIX TOLTECUS EXTENSUS.

Jour. N. Y. Ent. Soc., VII, p. 198, (1899).

Based on eighteen males and twenty-one females from six localities.

Single type here designated: ♀; San Bernardino, California, [July 16],[4] 1897; [Morse].

TETTIX CRASSUS.

Jour. N. Y. Ent. Soc., VII, p. 201, (1899).

Based on eighteen males and twenty-three females from two definite localities and the State record.

Single type here designated: ♂; Colorado; Morrison.

TETTIX HANCOCKI.

Jour. N. Y. Ent. Soc., VII, p. 200, (1899).

Described from fourteen males and fourteen females from a single locality.

Single type here designated: ♂; Ames, Iowa, [May 30]; E. D. Ball.

T[ETTIX] H[ANCOCKI] ABBREVIATUS.

Jour. N. Y. Ent. Soc., VII, p. 200, (1899).

Based on specimens from the type series of *Tettix hancocki*.

Single type here designated: ♂; Ames, Iowa, [May 24]; E. D. Ball.

TETTIX TENTATUS.

Jour. N. Y. Ent. Soc., VII, p. 200, (1899).

Based on one male and five females from four localities.

Single type here designated: ♀; Laggan, Alberta; Bean; Museum of Comparative Zoology.

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[4] The use of brackets in the present paper indicates authentic information not contained in the original description.

Nomotettix compressus.

Jour. N. Y. Ent. Soc., III, p. 15, (1895).

Based on two males and five females from a single questioned State.

Single type here designated: ♂; probably North Carolina; G. F. Atkinson; Cornell University.

Nomotettix cristatus denticulatus.

Psyche, XIII, p. 119, (1906).

Based on six males and one female from four localities.

Single type here designated: ♂; Denison, Texas, August 11, 1905; Morse.

Nomotettix parvus.

Jour. N. Y. Ent. Soc., III, p. 14, (1895).

Based on four males, one female and one immature specimen from one locality.

Single type here designated: ♂; St. Anthony Park, Minnesota; Lugger.

Tettigidea acuta.

Jour. N. Y. Ent. Soc., III, p. 15, (1895).

Based on three females from a single locality.

Single type here designated: ♀; New York; Uhler; Museum of Comparative Zoology.

Tettigidea armata.

Jour. N. Y. Ent. Soc., III, p. 107, (1895).

Described from two males and seven females from two known and one unknown locality.

TETTIGIDEA DAVISI.

Psyche, XV, p. 25, (1908).

Described from fifteen specimens from three localities.

Single type here designated: ♀; Perth Amboy, New Jersey, May 31; Wm. T. Davis.

TETTIGIDEA PRORSA ELONGATA.

Jour. N. Y. Ent. Soc., III, p. 16, (1895).

Described from two males and one female from a single State.

Single type here designated: ♀; Georgia; Museum of Comparative Zoology.

TETTIGIDEA SPICATA.

Jour. N. Y. Ent. Soc., III, p. 108, (1895).

Based on one male and two females from two localities.

Single type here designated: ♀; Florida; Morrison; Hebard Collection, Type No. 402.

PSEUDOPOMALA BRACHYPTERA REVERSA.

Psyche, VII, p. 343, (1896).

Based on material from unspecified localities.

Single type here designated: ♀; [Sudbury, Massachusetts, July 10, 1892; Morse.]

CORDILLACRIS AFFINIS.

Psyche, X, p. 115, (1903).

Based on one male and five females from a single county.

Single type here designated: unique ♂; Ormsby County, Nevada, lower edge of pine zone, 1,700–2,000 metres, west of Carson City, July 6; C. F. Baker.

ORPHULELLA OLIVACEA.

Psyche, VI, p. 477, (1893).

Based on one hundred and eighty males and one hundred and sixty-seven females from two localities.

Single type here designated: ♀; Stamford, Connecticut, August [13 to 17, 1891]; Morse.

CLINOCEPHALUS ELEGANS.

Psyche, VII, p. 402, (1896).

Based on five males and two females from two definite, two State, and one unknown locality.

Single type here designated: ♂; Ravenswood, Long Island, New York; Beutenmüller; Museum of Comparative Zoology.

CHLŒALTIS CONSPERSA PRIMA.

Psyche, VII, p. 420, (1896).

Based on an unspecified series from three localities.

Single type here designated: ♀; Sherborn, Massachusetts, 1895; Morse.

STENOBOTHRUS ACUTUS.

Psyche, X, p. 115, (1903).

Based on five males from a single locality.

Single type here designated: ♂; Ormsby County, Nevada, lower edge of pine zone, 1,700–2,000 metres, west of Carson City, July 6; C. F. Baker.

HIPPISCUS IMMACULATUS.

Psyche, XIII, p. 119, (1906).

Described from a unique male from Clarendon, Texas, August 18, 1905; Morse.

S[PHARAGEMON] ÆQUALE subsp. SCUDDERI.

Proc. Bost. Soc. Nat. Hist., XXVI, p. 225, (1894).

Based on eighty-eight males and ninety-eight females from eight localities.

Single type here designated: ♀; Sherborn, Massachusetts, July 25, 1892; Morse.

[SPHARAGEMON COLLARE] race ANGUSTIPENNE.

Psyche, VII, p. 298, (1895).

Based on nine males and four females from a single locality.

SPHARAGEMON INORNATUM.

Psyche, VII, p. 291, (1895).

Described from a unique female, Hot Springs, New Mexico, 7,000 feet.

SPHARAGEMON OCULATUM.

Proc. Bost. Soc. Nat. Hist., XXVI, p. 232, (1894).

Based on seven males and seven females from probably four localities.

Single type here designated: ♀; Marshall County, Indiana, August 1, 1892; Blatchley, (dried alcoholic).

SPHARAGEMON SAXATILE.

Proc. Bost. Soc. Nat. Hist., XXVI, p. 229, (1894).

Based on ninety-one males and sixty females from eleven localities.

Single type here designated: ♀; Blue Hill, Massachusetts, [September 20, 1891]; Morse.

SPHARAGEMON SAXATILE PLANUM.

Psyche, XI, p. 13, (1904).

Based on twenty-two males and ten females from a single locality.

Single type here designated: ♀; Wytheville, Virginia, September 4 to 5, 1903, 2,300 feet; Morse.

EOTETTIX PALUSTRIS.

Psyche, XI, p. 7, (1904).

Described from three males and one female from one locality.

Single type here designated: ♂; Live Oak, Florida, August 10, 1903; Morse.

EOTETTIX PUSILLUS.

Psyche, XI, p. 7, (1904).

Based on seventeen males and two females from two localities.

Single type here designated: ♂; Waycross, Georgia, August 11, 1903; Morse.

HESPEROTETTIX FLORIDENSIS.

Can. Ent., XXXIII, p. 130, (1901).

Described from fourteen males and four females from a single locality.

Single type here designated: ♂; Hastings, Florida, August 17 to 18, [1900; A. J.] Brown.

HESPEROTETTIX NEVADENSIS.

Psyche, X, p. 115, (1903).

Described from three males and three females from a single locality.

Single type here designated: ♂; Ormsby County, Nevada, lower edge of pine zone, 1,700–2,000 metres, west of Carson City, July 6; C. F. Baker.

BRADYNOTES COMPACTA.

Psyche, X, p. 116, (1903).

Described from four males and four females from a single locality.

Single type here designated: ♂; Ormsby County, Nevada, lower edge of pine zone, 1,700–2,000 metres, west of Carson City, July 6; C. F. Baker.

PODISMA SCUDDERI.[5]

Psyche, XIII, p. 120, (1906).

Described from a unique female from Cheaha [Chehawhaw] Mountain, Alabama, July 13, 1905, 2,300 feet; Morse.

PARATYLOTROPIDIA BEUTENMUELLERI.

Psyche, XIV, p. 14, (1907).

Based on a unique female, Valley of Black Mountain, North Carolina, August 30, 1906, W. Beutenmüller; American Museum of Natural History.

MELANOPLUS AUSTRALIS.

Psyche, XI, p. 13, (1904).

Based on a unique male, Savannah, Georgia, August 14, 1903; Morse.

MELANOPLUS DECEPTUS.

Psyche, XI, p. 9, (1904).

Based on eight males and eight females from a single locality.

Single type here designated: ♂; Jones Peak, Balsam Mountains, North Carolina, August 19, 1903, 5,700–6,100 feet; Morse.

MELANOPLUS DECORATUS.

Psyche, XI, p. 12, (1904).

Based on five males and sixteen females from four localities.

Single type here designated: ♂; Murphy, North Carolina, July 25, 1903, 1,800 feet; Morse.

MELANOPLUS DEVIUS.

Psyche, XI, p. 12, (1904).

Based on twenty-four males and twenty-one females from two localities.

Single type here designated: ♂; Wytheville, Virginia, September 4 to 5, 1903, 3,000–3,500 feet; Morse.

MELANOPLUS DIVERGENS.

Psyche, XI, p. 8, (1904).

Based on fifteen males and eighteen females from one locality.

Single type here designated: ♂; Balsam, North Carolina, July 24, 1903, 5,000–6,000 feet; Morse.

MELANOPLUS HARRISI.

Psyche, XVI, p. 12, (1909).

Described from a unique male, Needham, Massachusetts, August 23, 1908, rank herbage in upland field; Morse.

MELANOPLUS LATENS.

Psyche, XIII, p. 120, (1906).

Based on six males and ten females from four localities.

Single type here designated: ♂; Caddo, Indian Territory, August 9, 1905; Morse.

MELANOPLUS SCUDDERI LATUS.

Psyche, XIII, p. 122, (1906).

Based on two males from one locality.

Single type here designated: ♂; Bonita, Texas, August 14, 1905; Morse.

Melanoplus similis.

Psyche, XI, p. 9, (1904).

Based on three males from a single locality.

Single type here designated: ♂; Murphy, North Carolina, July 25, 1903, 1,800 feet; Morse.

Melanoplus strumosus.

Psyche, XI, p. 11, (1904).

Based on one male and four females from two localities.

Single type here designated: unique ♂; De Funiak Springs, Florida, August 5, 1903; Morse.

Melanoplus sylvestris.

Psyche, XI, p. 10, (1904).

Based on thirteen males and seventeen females from four localities.

Single type here designated: ♂; Blowing Rock, North Carolina, July 19, 1903, 3,500–4,000 feet; Morse.

Melanoplus symmetricus.

Psyche, XI, p. 8, (1904).

Based on three males and six females from a single locality.

Single type here designated: ♂; Carrabelle, Florida, August 9, 1903; Morse.

Melanoplus tepidus.

Psyche, XIII, p. 121, (1906).

Based on three males and three females from one locality.

Single type here designated: ♂; Meridian, Mississippi, July 16,

Melanoplus tuberculatus.

Psyche, XIII, p. 121, (1906).

Described from twelve males and three females from two localities.

Single type here designated: ♂; Quanah, Texas, August 21, 1905; Morse.

Scudderia cuneata.

Can. Ent., XXXIII, p. 130, (1901).

Described from a unique male, Alabama; Baker.

Xiphidium gracillimum.

Can. Ent., XXXIII, p. 236, (1901).

Described from five males and one female from two localities.

Single type here designated: ♂; [Miami], Biscayne Bay, Florida; Mrs. A. T. Slosson, Museum of Comparative Zoology.

Xiphidium occidentale.

Can. Ent., XXXIII, p. 202, (1901).

Based on sixty-nine males, sixty females and three immature specimens from eleven localities.

Single type here designated: ♂; Tehachapi, California, [August 3,] 1897; Morse.

X[iphidium] occidentale camurum.

Can. Ent., XXXIII, p. 202, (1901).

Based on a single female, Ashland, Oregon, September 7, 1897; Morse.

X[iphidium] occidentale caudatum.

Can. Ent., XXXIII, p. 203, (1901).

Based on one male and two females from a single locality.

Single type here designated: ♀; Mount Shasta district, California, July; H. Edwards, Museum of Comparative Zoology.

Xiphidium spinosum.

Can. Ent., XXXIII, p. 201, (1901).

Based on three males, two females and one immature female from a single locality.

Single type here designated: ♂; Coronado, California, July 24, 1897, on salt marsh; Morse.

XIPHIDIUM VICINUM.

Can. Ent., XXXIII, p. 203, (1901).

Described from sixty-one males and fifty-nine females from fifteen localities.

Single type here designated: ♂; Palm Springs, California, [July 10,] 1897; Morse.

[XIPHIDIUM VICINUM] form PRODUCTUM.

Can. Ent., XXXIII, p. 204, (1901).

Based on a portion of the typical series of *Xiphidium vicinum*.

Single type here designated: ♀; San Bernardino, California, [July 15,] 1897; Morse.

ODONTOXIPHIDIUM APTERUM.

Can. Ent., XXXIII, p. 129, (1901).

Based on twelve males, sixteen females and two immature specimens from one locality.

Single type here designated: ♂; Hastings, Florida, August [18 to 21, 1900; A. J.] Brown.

A BIOLOGICAL RECONNAISSANCE OF THE OKEFINOKEE SWAMP IN GEORGIA.

PREFATORY.

During the summer of 1912 a party of zoologists, all from Cornell University, visited the Okefinokee Swamp in southeastern Georgia, remaining seven weeks in the early summer (May 28 to July 13). The party consisted of Professors C. R. Crosby and J. Chester Bradley, of the Department of Entomology; Dr. A. H. Wright, of the Department of Zoology; Headmaster W. D. Funkhouser, of the Ithaca High School; Messrs. M. D. Leonard, S. C. Bishop and A. R. Cahn, of the class of 1913, and Paul Battle, of Bainbridge, Ga. Mr. E. L. Worsham, State Entomologist of Georgia, and Mr. Charles S. Spooner, Assistant State Entomologist, were with the party for a week. A smaller party from the same institution spent two weeks in the swamp in December, 1913 (December 18, 1913, to January 1, 1914). This party consisted of Professors James G. Needham and J. Chester Bradley, John T. Needham and Paul Battle. In addition, Dr. Bradley and Mr. Battle spent a week in the swamp in September, 1913, and Dr. Bradley had made very brief trips into the swamp in the fall of 1909 and the spring of 1911.

The object of all these expeditions was to study and put on record something of the biological conditions in this extensive fresh-water swamp, which still presents in a large measure primitive and interesting conditions of environment, before they should become forever changed by the now rapidly penetrating lumbermen.

Under the above title it is intended to publish reports upon the various groups collected, as studied. In due course a general account of the ecological and environmental features will be published. A report upon the birds, by Dr. Albert H. Wright and F. Harper, has appeared in *The Auk*, 1913, 4 : 477-505, Pl. XIV-XX. This contains brief descriptions of the various "habitats" of the swamp.

In the reports on the various groups, observations made and specimens collected during the summer of 1912 will be credited to the "Cornell University Expedition," abbreviated "C. U. Exp." This does not imply that the university had any official connection with the work. Each member of the party went on his own initiative and at his own expense.

THE REPTILES.

I. TURTLES, LIZARDS, AND ALLIGATOR.

BY ALBERT H. WRIGHT AND W. D. FUNKHOUSER.

Although the Okefinokee Swamp represents one of the most interesting regions in the southeastern United States for the study of reptilian life, practically no records have been made of this part of its fauna. The following paper is intended as a preliminary contribution toward a knowledge of the herpetology of this area—an area which is sure to prove a rich field for zoological work when suitable provision has been made to render its interior more accessible.

Few attempts have been made to enter the Okefinokee for scientific purposes. The swamp, in its earlier history, was a centre for beautiful Indian legends and mythical tales; in later times, this pathless wilderness occasioned a weird medley of stories, many of which reflect its supposedly dangerous attributes. The miasmatic effect of the "black mud, the stench from which soon became so intolerable as to induce vomiting," impresses Captain Rodenbough (1838)[1] as its worst characteristic; while another considers it "very dangerous to the health of man especially to recent arrivals in the country; . . . . in the Okefinokee mosquitoes sometimes rise in such swarms that the trees are only seen dimly as through a dust-storm." But with natives and travellers alike, a deterrent more powerful than either of these beliefs are the dreaded reptiles within its borders. Paul Fountain,[2] in his *A Day in a Cypress Swamp* (Okefinokee), devotes practically his entire chapter to these cold-blooded creatures. He says: "A greater number of reptiles may be found in this swamp than in any other spot I know of in the States," and our-

could be seen, to-day scarcely one may be found. It seems a very wanton destruction of life to kill so many of these large animals, especially when it is remembered that a large alligator hide is worth to the hunter only about $1.50."

"Just how soon (if at all) the alligator is likely to be exterminated in our Southern States it is impossible to say, but so long as those two great swampy wastes, the Everglades and the Okefinokee, remain undrained, the great American reptile is not likely to become entirely extinct."

Of this same form we have the very interesting account of Andrew Ellicott,[4] who served as the United States Commissioner to determine the boundary between Florida and Georgia in 1800. With the Spanish Commissioner, he started up the St. Mary's January 23, and returned March 3; and his mounds "A" and "B" have been the subject of many memorials by both Florida and Georgia. He writes:

"This being the season that the Alligators, or American crocodiles were beginning to crawl out of the mud and bask in the sun, it was a favorable time to take them, both on account of their torpid state, and to examine the truth of the report of their swallowing pine knots in the fall of the year to serve them, (on account of their difficult digestion) during the term of their torpor, which is probably about three months. For this purpose two Alligators of about eight or nine feet in length were taken and opened, and in the stomach of each were found several pine and other knots, pieces of bark, and in one of them some charcoal; but exclusive of such indigestible matter, the stomachs of both were empty. So far the report appears to be founded in fact; but whether these were swallowed on account of their tedious digestion, and therefore proper during the time those animals lay in the mud, or to prevent the collapse of the coats of the stomach, or by accident owing to their voracious manner of devouring their food, is difficult to determine.

"The Alligator has been so often, and so well described, and those descriptions are so well known, that other attempts have become unnecessary. It may nevertheless be proper to remark that so far as the human species are concerned, the Alligators appear much less dangerous than has generally been supposed, particularly by those unacquainted with them. And I do not recollect meeting with but one well authenticated fact of any of the human species being injured by them in that country, (where they are very numerous,) and that was a negro near New Orleans, who while standing in the water sawing a piece of timber, had one of his legs dangerously wounded by one of them. My opinion on this subject is founded on my own experience. I have frequently been a witness to Indians, including men, women and children, bathing in rivers and ponds, where those animals are extremely numerous, without any apparent dread or caution: the same practice was pursued by myself and people, without caution, and without injury.

"Some of the Alligators we killed were very fat, and would doubtless have yielded a considerable quantity of oil, which is probably almost the only use that will ever be made of them; however their tails are frequently eaten by the Indians and negroes, and Mr. Bowles informed me that he thought them one of the greatest of delicacies.

"The Alligators appear to abound plentifully in musk, the smell of which is sometimes perceptible to a considerable distance, when they are wounded or killed; but whether the musk is contained in a receptacle for that purpose, and secreted by a particular gland or glands, or generally diffused through the system appears somewhat uncertain: and I confess their appearance was so disagreeable and offensive to me, that I felt no inclination to undertake the dissection of one of them."

[4] Ellicott, Andrew. The Journal of, etc. Philadelphia, 1803. Pp. 276–278.

The bulk of the material described in the present paper was obtained by the expedition from Cornell University during the summer of 1912, at which time the swamp was entered from the southwestern side and a permanent camp established on Billy's Island, located in the centre of the swamp. From this camp side trips were made from time to time throughout the summer, and a fairly accurate idea of the geography and biology of the region was obtained.

Most valuable services were rendered to this party by the Lee family, living on Billy's Island, the only human inhabitants of the interior of the swamp, and practically out of touch with the outside world. Their primitive mode of living had adapted them to a marvellous degree to the appreciation of the wild life about them, and their observations and knowledge of natural phenomena proved to be surprisingly accurate. The older men and boys were indispensable as guides while the party was in the swamp, and on the exit of the party a container was left with them to be filled with specimens which might come to their hands later in the year. This container, full of material chosen with evident care and good judgment, was received November 15, 1912, and the specimens thus secured proved a valuable addition to those previously collected. In December, 1913, data were obtained on the winter condition of some of the forms here noted.

The list of species here described is of course hardly more than a check-list of those reptiles noted during the two months which the party spent in the Okefinokee, and is no doubt very incomplete as regards the extent of the reptilian fauna of the swamp, but it is hoped that it will serve as a basis for future work and as an aid to

TESTUDINATA.

1. **Macroclemmys temminckii** Troost. Plate I, fig. 3.

The alligator snapper, called by the natives "gator terrapin" or "loggerhead," was reported as being common in the Okefinokee, but very few specimens were seen by our party. No adults were collected. The presence of the alligator snapper in the Okefinokee carries its range eastward to the easternmost Gulf tributary (the Suwannee) and the former eastern boundary of old West Florida. Its association here with *Chelydra serpentina* suggests that the latter may have been an Atlantic coast contribution through the St. Mary's.

This turtle is said to attain a large size in its natural habitat in the lakes of this region, and some evidence was secured to bear out this statement. A specimen about eight inches in length was captured June 17 and placed in a "bee-gum" for safekeeping. On the return to the spot the next day, the turtle had escaped. Dave Lee stated that he had seen turtles with the head alone as large as the shell of this specimen. A skull of *Macroclemmys temminckii* with the lower mandible missing was found on one of the islands, and it proved by its measurements that this turtle approaches such a size. This skull, old and much weathered, agrees exactly with Boulenger's figure[6] in the arrangement of bones and sutures and in the position of the fossæ. It measures as follows:

Maximum length 6½ inches, maximum width 6 inches, width between centres of orbital sockets 2½ inches, diameter of orbit 1 inch, distance from eye to snout (between openings) 1 inch, height of upper mandible at anterior hook 2 inches, maximum width of upper mandible (at posterior angle) 4 inches, width of nasal opening 1 inch.

In connection with this data, a large scale, probably from the shell of an "alligator snapper," was found in the swimming hole at the boat landing on Billy's Island, June 9, 1912. This scale is flat, thin, hard and fan-shaped; on the upper surface eight radiating longitudinal ridges and numerous close, concentric, subparallel transverse grooves, the under surface smooth and slightly undulating. The scale is dry and brittle, much weathered and inclined to peel on the upper surface and is the cephalic scale of one of the costal series. Maximum length 5½ inches, maximum width 5½ inches, slightly broken on one side at distal angle.

No eggs of this turtle were collected.

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[6] British Museum Catalogue, Chelonians, 1889, p. 24, fig. 5.

2. **Chelydra serpentina** (Linnæus). Plate I, fig. 5; II, fig. 5.

Two young snapping turtles were brought out of the swamp and at the time were not carefully examined, but were supposed to be young of the alligator snapper. On comparison with similar-sized representatives of *Chelydra serpentina* taken at Ithaca, N. Y., they prove to be identical with the northern specimens. They are without the scalloped anterior margin of *M. temminckii* young, as represented by Agassiz[7] and do not possess the striking papillæ of the young of the alligator snapper. The orbits are directed outwards and upwards as in *C. serpentina* and wholly unlike the condition in the large skull of *M. temminckii* secured in the swamp. Furthermore, no supramarginals appear in the carapace. The specimens are small, the larger having a shell 1⅞ inches long by 1½ inches wide. A brief description may be given as follows:

Carapace grayish-black; very rough; three distinct ridges, the central highest; vertebral plates distinctly serrate at edges, inclined to overlap, each plate roughly bifid posteriorly; marginal plates thick, narrow, edges smooth anteriorly, strongly toothed posteriorly. Plastron acute posteriorly; black with white marginal markings. Head gray, skin tuberculate, white spot below angle of mandible on each side. Neck black, skin loose and wrinkled. Legs black, unmarked. Skin of head, neck, legs and under surface of body gray or black, rough and finely tuberculate. Tail long, black, spiny above, smooth below, gradually narrowing to apex.

3. **Cinosternum pennsylvanicum** Bosc. Plate II, fig. 3.

It is one of the common turtles of the swamp, found both on land and in the water. These turtles were often seen in the shallower waters of the lakes and in the ponds on the islands and frequently

behind; reddish-yellow, with deep brown rectangular grooves at inner and posterior edges of plates; interstices between hinges, and sutures between plates wide. Neck long; skin loose and much wrinkled; black above, sordid white beneath. Head comparatively large; black or brown above, occasionally spotted with yellow or greenish-yellow on sides, uniform white or yellow beneath; upper mandible with strong curved blunt hook. Legs unmarked, brown-black; claws long, strong and sharp. Tail thick and suddenly acuminate at extremity. Average length of carapace 3½ inches, width 2¼ inches; plastron 3¼ inches in length by 2 inches in width; height of shell 1½ inches; width of head ⅞ inch.

The time during which the specimens were collected (May and June) seemed to be the egg-laying season. A fine large female (C. U., No. 6,456) was taken on the nest in the act of egg-laying, June 11, 1912, and three eggs were found with the specimen. The nest was in rotten wood by the side of a dead log and the eggs were deposited at a depth of three inches below the surface of the decayed wood. In the stomach of a king snake (*Ophibolus getulus*) (C. U., No. 6,138) taken on Billy's Island, June 11, 1912, was found one egg of *Cinosternum pennsylvanicum*, together with two eggs of *Chrysemys floridana*. Another king snake (C. U., No. 6,146) taken on Billy's Island had what was apparently the shells of Cinosternum eggs in its stomach, and a third snake of the same species also taken on Billy's Island had in its stomach a large number of crushed and finely broken shells of the same kind of eggs. Finally, Mr. Harper relates how he and Dave Lee stumbled upon a king snake, and when they had recovered they found a small Cinosternum digging in the sand—all of which seems strong circumstantial evidence to prove the snake was on hand to scoop the eggs the instant they were laid. These turtles, therefore, evidently come up to the woody parts of the islands during this season to deposit their eggs, which often furnish food for the snakes and, according to the Lees, also for other animals of the swamp.

A number of the eggs of this turtle were collected, but owing to the evaporation of the liquid from the containers in which they were placed, none were preserved in a condition satisfactory for accurate description or measurements. The eggs were elliptical, approximately 30 mm. long by 15 mm. in diameter and of a pinkish-white color. The shells seem to be slightly more brittle and apparently less granular than those of *Chrysemys floridana*.

4. **Sternothœrus carinatus** (Gray).

Two specimens of musk turtles, agreeing with each other in every particular of structure and markings, were taken in the Okefinokee. These specimens represent an interesting form of *S. carinatus*. They differ from the normal in that the distinct black spots of the head are very obsolete and the black streaks or spots of the carapace, usually so prominent, are almost absent or only faintly visible. The gular shield is very small, a raised boss or knob.

The carapace is very rough, the vertebral plates sharp and inclined to overlap; dark brown in color, rubbed off to sordid yellow in spots; characteristic markings of carapace faint; both extremities of carapace obtusely rounded and slightly serrate, upper surface distinctly three ridged with central carina prominent; plastron almost solid, very narrow posteriorly and weakly notched behind; uniform yellow in color. Head dark brown with obsolete black spots, no lines above or below eyes; snout tapering and conical; under jaw with longitudinal black stripes. Legs uniform black; feet broadly webbed; claws thin and sharp. Tail thick and suddenly acuminate at apex. The larger specimen measures as follows: Length of carapace $3\frac{5}{8}$ inches, width $2\frac{1}{2}$ inches; length of plastron, $2\frac{7}{8}$ inches, maximum width 2 inches; height of shell $1\frac{1}{2}$ inches; width of head $\frac{7}{8}$ inch.

No eggs or young of this turtle were collected and no data were secured as to its habits or life history.

5. **Chrysemys floridana** LeConte. Plate II, fig. 4; III, fig. 6.

This is probably the commonest turtle on the islands of the swamp. They were often seen on the sandy banks where they came to deposit their eggs, or found sunning themselves on the logs in the lakes and crossways or in the smaller cypress ponds on the islands. These

scratches on the shell which are no doubt evidences of such encounters.

Thirteen adults, four young and a large number of eggs were brought out of the swamp and numbers were collected which were not preserved. The month during which most of the specimens were taken (June) seemed to be the egg-laying season. The eggs, usually numbering from twelve to twenty, were found in the sand. One female killed for soup, June 4, 1912, contained sixteen eggs ready for depositing. A bear, killed May 30, had in its stomach twelve eggs, one of which was whole, and signs were plentiful to prove that the bears dug these eggs from the sand. When an egg complement was found exposed or only partly covered by the sand, or with the complement very small, the natives asserted that the turtle had been disturbed in the midst of egg-laying by the attack of bears or had been frightened from the eggs by these animals.[8] A king snake (*Ophibolus getulus getulus*, C. U., No. 6,147), captured June 26, 1912, had fourteen eggs in its stomach. Another king snake (C. U., No. 6,140), taken June 3, had thirteen eggs in its stomach. The stomachs of three other specimens of the same species of snake contained, respectively, one, two, and six eggs of *Chrysemys floridana*. It seems very likely that other snakes and perhaps other mammals, such as coons, find the eggs of this turtle a palatable article of diet. The eggs were also eaten by the Lees, and those eggs which were immature and secured before fertilization had taken place were pronounced by members of our party excellent eating; the older eggs seemed bitter.

The natives called this turtle the "cooter," and it was also locally known as the "hard-back cooter."

The specimens taken showed little variation in structure or markings. Most of those captured were females with decidedly convex plastron. The size of the shells of the mature specimens averaged about 1 foot in length by 11 inches in width and 5 inches in height. The largest specimen taken (No. 6,433) measured as follows: Length of carapace 13½ inches, width 12 inches; length of plastron 11½ inches, width 6½ inches; height of shell 5½ inches. The adult of *Chrysemys floridana*, as found in the Okefinokee, may be described as follows:

Carapace very high and dome-shaped; black-brown; vertebral plates smooth except anterior and posterior ones which are slightly wrinkled; costal plates with deep longitudinal wrinkles on upper

[8] In the middle of May, 1912, Mr. Harper reports that the edges of the canal were literally torn up by bears, coons, etc., which search for "cooter's" eggs.

three-fourths, lower fourth with transverse ridges; marginal plates smooth or lightly longitudinally rugose, the posterior sometimes slightly serrate at joints; vertebral plates marked with heavy longitudinal yellow line on each side of middle with fainter cross-lines of same color; costal plates with broad median yellow line extending outward, often bifurcate at distal end and sometimes surrounded with hieroglyphics of wavy lines of the same color; marginal plates with distinct median yellow band extending outward, rarely fainter bands on each side. Plastron uniform lemon-yellow, convex anteriorly, deeply notched posteriorly; edge of marginal plates with black spots beneath, varying in number, but usually five on each side. Head very small; eyes large; head and neck striped with yellow; median longitudinal bifurcated yellow-white line on underside of head, sometimes with white line inside bifurcation and yellow line on either side. Legs and feet deep brown-black marked with yellow stripes. Claws very long, the middle three of the anterior limb longest.

One specimen was taken in which the median stripe of the marginal plates was decorated on each side with a semicircular line followed by a short bar, thus agreeing with Holbrook's figure.[9]

The young specimens collected lacked the high, dome-like carapace of the adults. The shells were almost round and about $1\frac{1}{2}$ inches in diameter.

Description.—Carapace slate-colored, averaging three-fourths of an inch in height and abruptly keeled in the middle. Costal plates smooth with distinct median white line sometimes bordered by faint wavy lines of the same color. Marginal plates smooth, edges serrate at joints, decorated with median white line followed on each

34.16 mm., and the average diameter 24.15 mm.; the mode 35 x 24 mm.; the maximum length 40.5 mm., and the maximum diameter 27 mm.; the minimum length 33 mm., and the minimum diameter 22 mm.

6. **Chrysemys reticulatus** Bosc.

Three specimens of *Chrysemys reticulatus* were secured in the Okefinokee, two on Billy's Island and one on Honey Island. The field notes of members of the party do not record any others as having been seen, and it is probable that this is one of the less common turtles of the swamp. The specimens secured agree with the published descriptions and there can be little doubt as to the identity of the species.

The largest specimen, which is probably most typical in all respects save the markings, may be described briefly as follows:

Carapace dull brown; thickly covered with fine reticulated grooves; each plate with a distinct flat marginal border; shell rather high, smooth in general outline; marginal plates with obsolete median yellow line; under side of each marginal plate with black spot, sometimes coalesced with that of the neighboring plate. Plastron smooth, reddish-yellow, median plates with a distinct tinge of red. Neck very long, skin loose, black. Head brown above with faint yellow markings; yellow beneath with distinct reticulated brown lines. Fore legs with wide yellow band in front, yellow below; feet black beneath; claws long. Under surface of hind legs and tail yellow; hind legs with alternate black and yellow lines posteriorly; tail with two black lines on under side. Measurements: Length of carapace $8\frac{1}{2}$ inches, width 7 inches; length of plastron $6\frac{3}{4}$ inches, width 4 inches; height of shell $3\frac{1}{2}$ inches; width of head $1\frac{1}{16}$ inches; interorbital space less than $\frac{1}{2}$ long diameter of the eye; orbits distinctly upwards and outwards in direction.

The second specimen differs from the first only in size, in having the carapace somewhat indented and in the darker colors and less conspicuous markings. In this specimen the lines on the under side of the head are more nearly parallel, and the yellow color less evident on the legs. The under side of the marginals would be wholly without black spots but for three very indistinct ones. The two spots on the bridge are widely separated.

The smallest of the three specimens was found on Honey Island and differs from the others only in the markings of the carapace and in the more brilliant colors of the body. The carapace of this specimen is smooth, without grooves, and beautifully decorated with

bright yellow, narrow reticulated lines covering the vertebral and costal plates; the marginal plates have a distinct median yellow band, in some instances this is connected with reticulate lines of vertebral and costal plates. The plastron is clear lemon-yellow with black band at extreme outer edge of abdominal and pectoral plates and on the axillary and inguinal plates. There is no variation in the pattern of the markings from that of the older and larger specimens, but the colors are much more evident.

No data were obtained as to the life history or the habits of this species.

7. Terrapene carolina Linn.

One specimen of *Terrapene carolina* was taken on Honey Island, June 2, 1912. The natives of the swamp call all box turtles "lock-ups," and report that they are comparatively numerous, but only two specimens were collected during the time our party was in the swamp, one *Terrapene carolina* and one *Terrapene major*.

The specimen of *Terrapene carolina* taken measured $6\frac{1}{2}$ inches in length, with a plastron (completely closed) $5\frac{1}{4}$ inches long; the total height of the shell $2\frac{7}{8}$ inches. Carapace dome-shaped, higher behind than in front, smooth as to general surface but with slight indentations on the middle vertebral plates; entirely covered with irregular dark yellow spots recalling Ditmar's comparison[10] of having been spotted with a brush. At the external margin of the costal plates a few irregular yellow lines extend outward. The shell shows no keel and the marginal plates are not flared. The edges of the marginal plates are yellow and the under side of the same plates marked with brown posteriorly. Plastron uniform yellow, interstices

line extending the entire length of the carapace, and the groups of radiating yellow lines marking the costal plates.

The carapace is chocolate-brown in color with characteristic radiating yellow lines on the upper surface of the costal plates and subparallel yellow bands extending outward on the external margins; each plate is marked with regular concentric subrectangular grooves. Plastron (closed) 5⅜ inches in length and 3⅛ inches in width; uniform yellow in color with a reddish-brown spot on the external posterior angle of each plate; all plates showing parallel grooves along the median line, and in the case of the abdominal plates these grooves make a right angle at the median anterior corner of the plate and extend laterad reaching the margin. Under side of marginal plates yellow with irregular markings of brown.

In the one specimen taken, the posterior end of the shell is somewhat mutilated.

9. **Platypeltis ferox** Schweigger. **Plate I, figs. 1, 2, 24; II, fig. 6.**

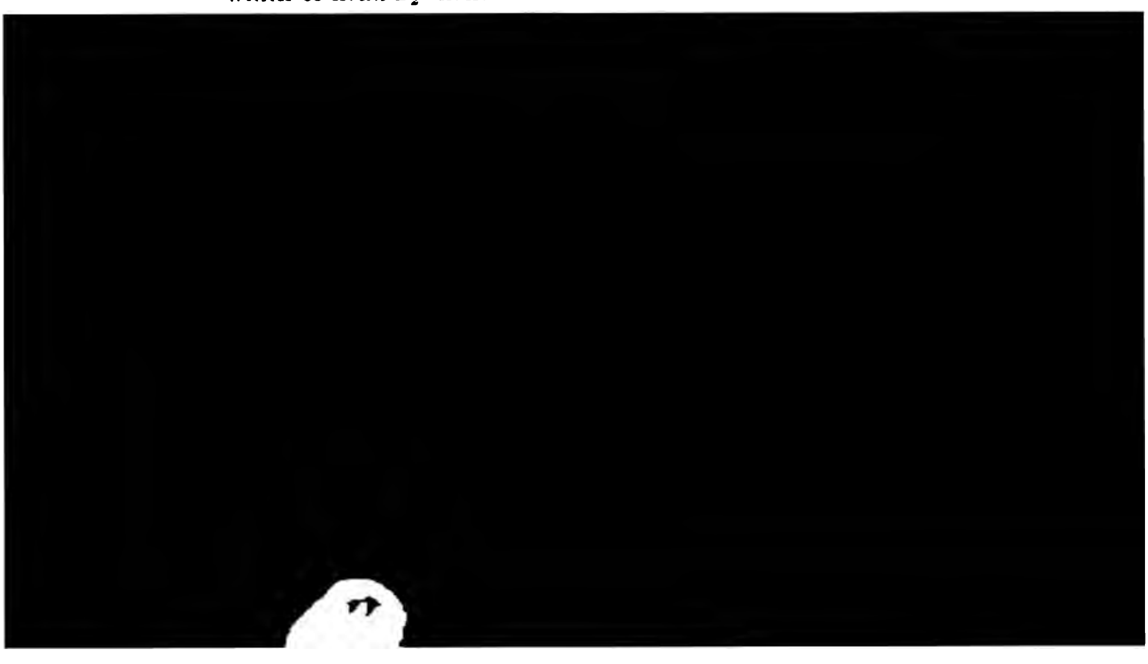
This species is common throughout the swamp. Adults, young and eggs were collected, and the field notes show that this turtle was recorded from Billy's Island, Honey Island, Floyd's Island, Mixon's Hammock, Billy's Lake, Minne Lake and Sweet Water. This species is doubtless to be found in all parts of the Okefinokee, and is especially abundant in those places where the water is deep and the bottom soft. The natives claim that soft-shelled turtles are to be found wherever there are alligators, and this fact seems to be borne out by the observations made on these turtles. On May 31, 1912, an attempt was made to seine a "'gator hole" on the Honey Island Prairies. Before seining, Bryant Lee went over the hole "grunting," a method locally used to start the alligators, which animals, it is claimed, will respond to this peculiar vocal accomplishment and show their presence by rows of bubbles on the surface by which they may be followed. In this instance the supposed alligator was pursued for some distance, only to prove to be a large *Platypeltis*. It is not improbable that the deep, secluded "'gator holes" may furnish a favored retreat for this turtle whose ability to defend itself by its powerful mandibles and snake-like bite is well known and may be sufficient protection against the alligator itself. According to the Lees, this turtle is very active and can use its legs to a remarkable degree, especially while in the water, and plenty of evidence was secured to show that its legs and knife-edged beak were no mean weapons. A captured specimen, a foot or more in length, which was kept around the camp for several days, showed a sur-

prising ability to dig through the sand and could jump forward practically its own length.

On account of the size and weight of this turtle, it was impracticable to carry a large series out of the Okefinokee with the limited means of conveyence afforded to the expedition, but sufficient data were secured from the large number of specimens observed to give a fairly accurate account of their appearance, habits and life history. A number of heads, skulls, carapaces, young turtles and eggs, both mature and embryonic, were collected and brought out of the swamp, and notes were made on the adults in their native environment.

The adult turtle may be described as follows from an average specimen taken June 12, 1912, on Billy's Island, and preserved as C. U., No. 6,471.

Carapace chocolate-colored with obsolete irregular patches of black; strongly tuberculate at anterior end, with faint, subparallel, longitudinal rows of tubercles extending the entire length of the vertebral and costal regions of the carapace and becoming more prominent and pronounced at the posterior end; marginal area soft and flabby, especially at posterior half. Plastron smooth, yellowish-white, extending well forward and somewhat exceeding the carapace, almost entirely covering the fleshy parts anteriorly, narrower behind and leaving much of the posterior part of the body exposed. Head comparatively small, smooth, brown, markings very faint; snout developed into a long fleshy proboscis; lips fleshy. Tail thick; vent close to end; extremity of tail suddenly acuminate beyond vent. Measurements: Carapace $15\frac{1}{2}$ inches long, 11 inches wide; plastron $11\frac{1}{2}$ inches long, 10 inches wide; height of shell 5 inches; width of head $2\frac{1}{2}$ inches.



The complete skull of a soft-shelled turtle, with cartilages of mandibles still attached, was found on Billy's Island, June 19, 1912. This skull agrees with Boulenger's short description[11] and in all general features with Hegner's figure,[12] and, while much weathered, shows the bones and sutures in excellent shape. It is remarkable for the high supraoccipital ridge (the two squamosal ridges being damaged) and for the very flat temporal region.

This skull measures $3\frac{3}{4}$ inches in length, $2\frac{1}{2}$ inches in width, $\frac{1}{4}$ inch between eyes, diameter of sockets $\frac{5}{8}$ inch, distance from orbital to nasal opening $\frac{3}{8}$ inch, length of lower mandible $2\frac{1}{2}$ inches, width of lower mandible at posterior angle $2\frac{1}{4}$ inches, height of lower mandible at middle $\frac{1}{2}$ inch, distance between orbit and auditory cavity $\frac{3}{8}$ inch, distance from orbit to margin of upper mandible $\frac{1}{2}$ inch, maximum height of head, including both mandibles, $1\frac{3}{4}$ inches.

Several carapaces of *Platypeltis ferox*, much weathered and usually more or less mutilated at the edges, were found on Billy's Island.

Such a carapace shows the upper surface white and finely reticulate, with pits prominent and the sutures distinct. Nine neural plates are present, the anterior very broad and without corresponding costals on either side (*i.e.*, is a nuchal); in form rectangular, about twice as long as wide. Seven costal plates on each side, parallel and regular, and extending transversely across the carapace. The marginal area appears brown and leathery, the plates fused. The under surface of the carapace is smooth and yellow-white. The ribs are prominent and imbedded in the plates of the carapace; eight on each side, extending more or less radiately from the vertebral column. This column is likewise fused with the carapace and presents nine vertebræ. One carapace with nine neural plates had eight, not seven, pairs of costal plates, the last two pairs meeting on the median line where the neurals are absent. These carapaces are about 9 inches in length, 8 inches in breadth and 2 inches in height.

A good series of young soft-shelled turtles were collected in the swamp and preserved. These range in size from $1\frac{5}{8}$ to $3\frac{1}{8}$ inches in length and show plainly the brilliant, characteristic markings of the carapace, especially when the shells are wet. The smallest specimens agree well with Ditmar's figure.[13]

The carapace is gray-black, strongly marked with irregularly

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[11] Brit. Mus. Cat., p. 259.
[12] College Zoology, p. 530, fig. 440—from Zittel.
[13] Reptile Book, p. 76, Pl. 26.

placed round black spots. Vertebral and costal regions finely, longitudinally rugose with broken lines of linear tubercles; anterior tubercles very small. The marginal area smooth, brown and broadly edged with white. Plastron soft, slate-colored, a white spot on each side of the median line; plastron extends far forward, exceeding the carapace anteriorly, short behind, leaving posterior fleshy parts exposed. Head, neck and under parts of body black. Neck long, skin loose and much wrinkled. Snout long, white beneath, white spot at base of snout with white line from this spot to each eye, and white line at edge of mandibles.

As the specimens become older, the gayly colored markings of the carapace become less distinct and have disappeared on turtles which have attained a length of 6 inches. The anterior tubercles of the shell become better developed and the whole carapace rougher. The plastron grows lighter in color and the head uniformly darker, with the markings obsolete. A small specimen of a young soft-shelled turtle was found in the stomach of a water moccasin (*Ancistrodon piscivorus*, No. 6,214) taken late in the summer. Very likely, while in this soft-shelled, fleshy state, these turtles furnish an acceptable addition to the food of the larger snakes and perhaps to other animals of the swamp.

Eggs of *Platypeltis ferox* were easily secured. They were usually found in the sandy fields and occasionally the turtles were captured at the places of oviposition. The eggs were generally deposited in two or three inches of sand in some place where the surface of the earth was warmed by the direct rays of the sun. One complement of twenty-two eggs was discovered, June 26, on Floyd's Island in which the eggs were uncovered. This was probably due, however,

According to the data secured, it would appear that the egg-laying season for this turtle is represented by the months of June and July. The young turtles feed on fish and frogs, and according to the natives the larger specimens devour also such water fowl as are unfortunate enough to be taken unaware by these reptiles. They frequent the deepest parts of the streams and lakes, but come out to the sandy portions of the islands to deposit their eggs. They are vicious, active, and are among the largest of the Reptilia of the Okefinokee.

LACERTILIA.

10. **Anolis carolinensis** Cuvier.

Common throughout the higher portions of the swamp. Most common on the islands, but seen also on bushes in the swamp proper. Recorded on Billy's Island, Gallberry Island, "The Pocket," Honey Island, Mixon's Hammock, Minne Lake Islands, in the crossway between Billy's Island and Gallberry Island and on the trail from Billy's Island to Minne Lake Islands. Found chiefly on large bushes and small deciduous trees, where it dodged around the limbs at the approach of the collector. This species is quite active and adept at climbing.

The Okefinokee specimens are practically uniform in size and structure. Several of the specimens had suffered the loss of part of the tail, but the measurements of body parts showed little variation. The average length of the body to vent was 50 mm., and of the tail about 90 mm. In life the usual color of the dorsal surface of the body and tail was light green; the ventral surface almost white, except the belly, which was blue or bluish. The alcoholic specimens show the dorsal colors ranging from slate-gray to dark blue-green, with the ventral surface of the head, throat, and breast showing shades of pink with minute dark spots in longitudinal rows, and the throat often having a loose reddish fold. The belly ranges through various shades of gray and blue, with the vent and under surface of the hind legs lighter. The tail is uniformly blue-green below.

The scale and plate arrangement proved to be practically constant. The dorsal head ridges in the smaller specimens were sometimes more or less indistinct, but generally showed 11 to 15 plates. The *canthus rostralis* uniformly consisted of six plates; the upper labials of 10 to 12; the lower labials of 11 to 13.

The nostrils appear on a line between the first and second superior labials and above the *canthus rostralis*. The latter is always well

developed and prominent. The rostral plate is very broad. The lower jaw has no median symphyseal plate, the first infralabials of the two sides meeting on the median line.

No data were secured which would give any information regarding the breeding habits of the species in the swamp.

On December 22, 1914, Dr. Bradley found a small, shriveled specimen of *Anolis carolinensis* in a pitcher plant. From a botanical standpoint, it would be interesting to know whether this plant is able to capture forms as large as this lizard.

Incidently it may be noted that this was the only lizard seen by Dr. Bradley on this trip, and it would appear that the lizards are not commonly out at this season of the year.

11. **Sceloporus undulatus** Latrielle. Figs. 1, 2.

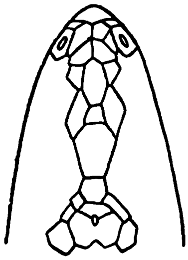
Abundant throughout the higher and drier portion of the Okefinokee and called by the natives "scaly lizard." Most common on the sandy pine lands, where they seem to prefer the fallen timber, logs and stumps, and always to be found around fences and piles of cut wood. Very active and, like many of the other lizards, difficult to secure without the loss of some portion of the tail.

The specimens taken proved to be fairly uniform in size, the largest measuring 155 mm. in total length and the smallest 122 mm. In the comparative measurements the figures show a pronounced agreement. The length to vent is slightly less than one-half the total length; the length of the fore leg almost exactly equal to the distance from the anterior end of the head to the axilla; the hind foot about one-half the length of the hind leg, and the width of the head about equal to the length of the fore foot.

The femoral pores are always present, ranging in number from thirteen to fifteen, and sometimes very prominent on the summit of a high ridge.

The plates of the head are clearly defined and easily distinguished, but in some regions most irregular and complicated in arrangement. The specimens usually show five supraorbitals (in three cases six) separated from the median plates of the head by a single row of small scales and bordered externally by two or three rows of superciliaries. The usual arrangement of these superciliaries is in two irregular rows with occasionally one or two plates of a third row. The labial plates appear very uniform, the superior row containing five plates and the inferior six. In one or two of the larger specimens this was increased to 6–7.

The plates of the median dorsal region of the head, however, present a most interesting variation. It is of interest to note that no two of the specimens taken were alike as to the number and arrangement of the plates of this region, although all were collected in the same locality within a period of one month. A discussion of these plates is rendered difficult by the fact that the descriptions by various authors differ widely in terminology, and it is not easy to determine upon consistent names for the series of plates which may be found. The occipital is large and polygonal and sometimes subdivided (Nos. 6,408, 6,414, 6,415). It contains the pineal eye, which is always present. This plate is bordered by a row of smaller plates ranging in number from four to seven (cf. Nos. 6,413, 6,417 and 6,418). Anterior to the occipital in a small single plate, sometimes adjacent (No. 6,410) and sometimes separated by the two anterior plates of the bordering row (No. 6,411). The next plate anteriorly is a large pentagonal or hexagonal plate slightly anterior to the middle of the eye. The next row may consist of two or of three plates. If of three, the middle one is small (cf. Nos. 6,402, 6,406 and 6,413). The next plate is large and may be subdivided to form an irregular transverse row. The single condition is shown in Nos. 6,405, 6,406, 6,407, 6,414 and 6,415; the subdivided condition in Nos. 6,409 and 6,412. Anterior to this plate, and between it and the internasals, there may or may not appear a row of plates (when present usually three), more or less regular and usually pentagonal. This row is shown in Nos. 6,405, 6,406, 6,407, 6,415, 6,417 and 6,418. The two internasals are comparatively large, very irregular in shape and seldom bilaterally symmetrical. They are almost directly above the nostrils. They may be subdivided (No. 6,410),



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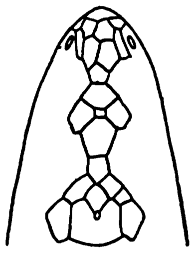

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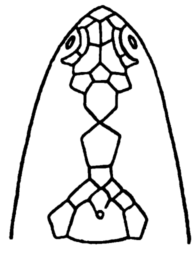

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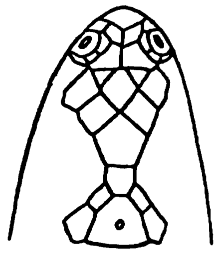

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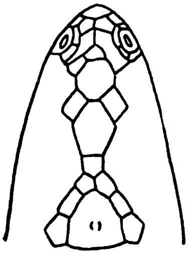

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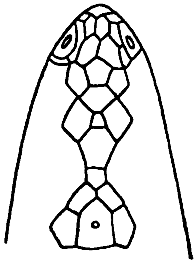

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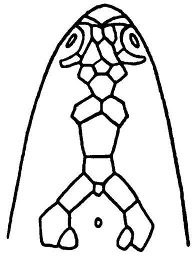

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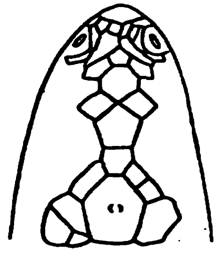

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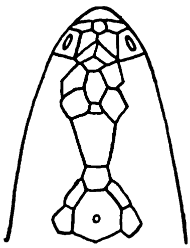
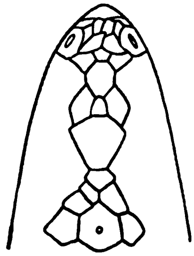
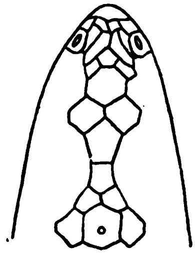
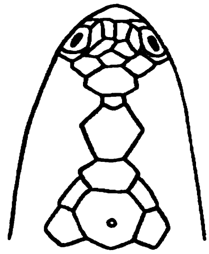


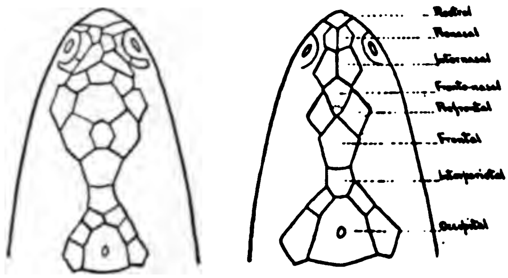






or one may be subdivided and the other not (Nos. 6,408 and 6,411). Between the internasals and the rostrum appear two plates, usually unsymmetrical, and apparently twisted out of position. Their longest diameter may be transverse (No. 6,412) or longitudinal (No. 6,413), and there is sometimes found a third plate in the row (No. 6,409).

In spite of the fact, however, that all of these median plates of the head may be so irregular, so twisted from a bilateral condition,



6416 Hypothetical

Fig. 2.—*Sceloporus undulatus* Latr. Plates of the head.

so confusing in arrangement, and so liable to subdivision, it might be pointed out that the *series* of rows is comparatively uniform. The hypothetical arrangement of the most simple condition might be represented by the figure (fig. 2), and from this arrangement all of the variations shown could be developed. Whether such a simple arrangement would represent the most generalized form or not would be a matter of conjecture.

12. **Ophisaurus ventralis** Linn. Fig. 3.

Three specimens of *Ophisaurus ventralis* were taken in the Okefinokee. The Lees, however, report that this lizard is not uncommon and call it the "grass snake," giving as an explanation of the name the fact that they have noticed that its locomotion appeared difficult except in grassy places. They apply the name "joint snake" to an entirely different reptile, which they describe as having joints around the body and which may be *Rhineura floridana*, although no specimens were seen of this form. The three specimens collected were taken in the grass on Billy's Island, but no data were secured as to their life history or habits.

The two smallest specimens are quite different from the third and largest and may be discussed first. These specimens measured,

respectively, 590 mm. and 355 mm. in length, the chief difference being in the length of the tails. The longer of the two measured 162 mm. to vent and the smaller 127 mm., while the distances from tip of rostrum to eye and to ear in both specimens were identical. The head of the longer specimen was 1½ mm. broader than that of the other. The two specimens agreed in scalation and in color. The dorsal surface was light, rather cinnamon-brown, with three very dark brown longitudinal stripes, two lateral and one dorsal, the dorsal being slightly fainter than the lateral. The sides of the head and of the anterior part of the body appear spotted; the entire ventral surface of body and tail uniform lemon-yellow. The dorsal rows of scales, of which there are sixteen, are separated from the ten ventral rows by a distinct groove. The preanal scales are slightly larger than the abdominal. The dorsal scales of the body are carinate and are wider than long. The color and stripes therefore agree with Cope's description of variation "11. J."[14]

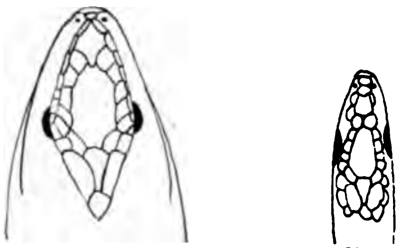


Fig. 3.—*Ophisaurus ventralis* Linn.

The plates of the head show the interfrontonasals separated from

show in the least the typical compression which distinguishes that subspecies. In coloration these two specimens apparently agree with *U. S. Nat. Mus. Cat.*, No. 10,584, which Cope said restrained him "from regarding the form *compressus* as a distinct species." It is, nevertheless, interesting to note the gradation, since it makes these forms from the swamp seem to stand between the typical *ventralis* and its unique subspecies, the standing of which may be subject to question.

The largest of the three specimens is quite distinct in color and form, although found in exactly the same locality, and may be briefly characterized as follows:

Body very stout and thick; dark brown above with many small white spots irregularly placed on the head, and in more or less regular longitudinal and transverse rows or lines on the dorsal surface of the body and tail, giving the whole a checkered appearance. The stripes are obsolete. Under surface of body sordid yellow-white; the tail clear lemon-yellow beneath. There is but one interfronto-nasal, and the superior labials do not touch the orbit. Superior labials ten in number. Length 525 mm., maximum width 20 mm., length to vent 265 mm.

13. **Cnemidophorus sexlineatus** Linn. Plate II, fig. 2.

Apparently common throughout the islands of the swamp. Certainly one of the most common lizards on Billy's Island. Also numerous on Honey Island and Minne Lake Islands. This lizard, in spite of its swiftness, was easier to secure in the field than the other common species on account of the fact that it did not possess the disconcerting habit of dashing along fences and through the underbrush.

It is locally known as the "race-nag," a name which, like many of the other names used by the inhabitants of the swamp, was strikingly descriptive, since the lizard is so remarkably active and scurries over the ground with surprising speed when disturbed. It appeared most abundantly in the plowed fields where the Lees had planted corn, peas and goobers, and since these plowed fields are very sandy, the common name of "sand lizard or swift" is quite appropriate. They were commonly seen among the "goober" vines where their colors blended well with the lights and shadows under the leaves. These lizards seemed to prefer the bare furrows for sunning themselves, and in the raised earth between the furrows had dug their holes, into which they darted when disturbed. These burrows extended in irregular directions to a depth of 8 or 10 inches,

which made the digging up of the lizards a comparatively easy task. Between the plowed furrows, also, in holes from 4 to 12 inches deep, were deposited the eggs, usually four or five together. The eggs were about 16 mm. in length by 10 mm. in greatest diameter, ellipsoidal, comparatively soft, semitranslucent, and almost salmon-colored; not smooth or shining, but slightly rough and subpubescent.

Little data were secured on the life history or the breeding habits, but from the fact that eggs were secured at this time—June—and also the fact that several of the specimens taken showed the blue abdomen characteristic of the breeding male, it is evident that this month represents at least a part of the breeding and egg-laying season. Since, moreover, the reptilian developmental period is comparatively long, the bulk of ovulation must have been practically over, or some of the females taken would have been found with eggs, which was not the case. Specimens of *C. sexlineatus* were found in the stomachs of two blacksnakes (*Zamenis constrictor constrictor*, C. U., Nos. 6,157 and 6,155), a fact which shows that this species of lizard, like many others, shares the fate of providing food for the larger reptiles of the swamp.

The variations of the specimens taken are especially interesting from the fact that all those described are from one locality and were all taken within a period of approximately a month, so that the variations cannot be explained by season or habitat.

A number of striking differences may be observed in the Okefinokee forms as compared with Cope's description and figure,[16] which were used as a basis for study. It should be noted that the figure shown by this author (p. 594) does not agree with the description (pp. 594–596). This is particularly true in the discussion of the head and

length of No. 9,256, U. S. N. M., which is given by Cope as typical. A table of measurements of various parts of the body shows a close agreement in the relative sizes of body parts. The plates of the head agree fairly well in number, but differ greatly in size and shape. One of the most variable of the plates is the first supraorbital, which may be entire, cleft, parted or completely divided, cutting off a small caudolateral portion as a separate plate. The frontoparietals are usually subequal to the parietals, but are sometimes smaller, seldom larger. The frontal is usually pentagonal in shape, but the surface varies from a deeply three-ridged condition, which is the most common, through an obsoletely three-ridged surface to one practically flat or slightly convex. The interparietal plate is sometimes bifid, sometimes flat, but oftenest high at the centre and at the edge, with a submarginal depression or moat which is well defined. Posterior to the parietals and interparietal the plates are most irregular and variable. In some specimens one or two distinct rows of plates are found in this region, with from five to eight plates in a row; in others only one well-defined row is present, and this is often interspaced with very small plates or scales; more often all of the plates of this region are small and indefinite in arrangement. The superciliaries of the orbit vary from three to six, the usual number appearing to be five. Of these the anterior two are carinate and the others are convex or flat. The inferior orbitals range from three to five, the anterior and posterior being usually small. The superior labials are generally five in number; one specimen examined showed seven, two had six, and one, four. One of the most constant of the characters of the species seemed to be the femoral pores, of which fifteen were found in the most typical specimens, the range being from thirteen to seventeen, but other numbers than fifteen appearing very rarely. The anal plates, on the other hand, were decidedly variable. In the majority of cases these plates agree with Cope's description: "three large scales, placed in a triangle, two posterior to the other and with smaller scales behind." This arrangement seems to be typical, but even in the comparatively small series from the Okefinokee one specimen was found with only one anal plate, four with two—one posterior to the other—one with three in a longitudinal row, and several showed a wide granular space between the plates and the vent. In other regions the plates are quite uniform and agree well with the arrangements noted by Cope.

The color is quite constant and the stripes persist through life, never becoming obsolete. A faint brownish band, sometimes

double, is often found extending down the median dorsal line of the body. The scales of the fore leg, hind leg and thighs are practically without variation in the specimens studied.

It might be noted that in many of the specimens recorded from the Okefinokee the plate arrangement agrees much more nearly with the figure and description of *Cnemidophorus septemvitattus* Cope than with *C. sexlineatus*. This is noticeably true of the anal plates, the general head structure and, in some cases, the femoral pores. In fact, if the median dorsal longitudinal line which sometimes appears were more distinct, some of these specimens would seem to merge into the typical *septemvitattus*. None of these specimens, however, are as large as the type of *septemvitattus* (No. 2,872, U. S. N. M.), nor do any show the colors of the unique specimen of Cope's species, which appears quite distinct, resembling western forms in general appearance and coloration, although the locality given for the type specimen is denied by Van Denburgh,[17] and the species does not seem to be as firmly established as might be wished.

14. **Lygosoma laterale** (Say).

Not common. Only eight were taken in the swamp and but a few others were seen. Of the eight specimens collected, one was found under the bark of a log, one at the edge of a small stream, almost in the water, one under leaves in the woods, and the rest on the ground in open places. This species seemed comparatively slow of movement and was not particularly difficult to capture.

The specimens showed no peculiarities of markings or of plate arrangement. The colors of the alcoholic specimens seemed to be more or less obscured, but the dorsal surface usually retained the characteristic bronze sheen, and the lateral stripes, although some-

The specimens were remarkably uniform in both comparative and in actual measurements, the differences being chiefly in general body and tail lengths, rather than in variation in size of limbs or in distances between fixed points.

In the discussion of the plates and scales of this species it should be noted that Cope's description[18] is most unsatisfactory, the terminology being confused, if not actually inaccurate.

The description given by G. A. Boulenger in his *Cat. Lizards Brit. Mus.*, 1887, Vol. III, p. 263, proved the most useful and accurate.

In the Okefinokee specimens the dorsal plates of the head are absolutely uniform and may be described as follows:

Rostral short; internasal pentagonal; nostrils piercing nasals; no supranasals; frontal in contact anteriorly with internasal, and two prefrontals widely separated posteriorly from interparietal by two broad frontoparietals; interparietal kite-shaped, much longer than wide; parietals 2; supraorbitals 4; superciliaries 7; superior labials 7.

Little data were obtainable regarding the life history of *Lygosoma laterale*. No eggs were found.

15. **Plestiodon quinquelineatus** Linn. Fig. 4.

Common throughout the higher portions of the swamp and on the islands. Seemed to be particularly fond of deserted buildings and chimneys where any such structures occurred, and often found along fences. The larger forms were called by the local names of "red-headed scorpion" and "red-headed lizard," while the smaller striped forms seemed to have no common local name, being probably confused by the natives with *Cnemidophorus sexlineatus* Linn. *Plestiodon quinquelineatus* was seldom seen on the ground or on the trees, but was often found stretched out in the sun on dead logs, stumps or fallen timber.

Although this was one of the most common of the lizards noticed in the Okefinokee, comparatively few specimens were collected on account of the fact that their habits made it a difficult matter to secure them, since they dashed into crevices and holes or darted along the fences or into the brush on the least provocation. They were abundant in the deserted log buildings on Billy's Island and were seen in large numbers in and around the old, abandoned house on Mixon's Hammock, where they scurried over the ruined floor and over the decayed timbers of the walls, only to dart into the cracks

[18] Rept. U. S. Nat. Museum, 1898, p. 622.

at the approach of the collector. In fact, had the object been the securing of "tails" rather than lizards, the collecting would have been far more successful, since the small blue-tailed form, particularly, was prone to leave a tail wriggling in the collector's hand while its owner scurried to safety.

Enough specimens were collected, however, to show practically all of the stages usually recorded, from the small, black, brilliantly marked form with the clearly bifurcated median stripe to the large, brown, red-headed stage with the plain brownish coloration, broad head and obsolete bands.

The specimens naturally varied much in size as well as in coloration, the smallest taken being 92 mm. long while the largest measured 237 mm. The coloration of the ventral surface of the body and head seemed to vary according to the colors shown by the dorsal region. For example, in the distinctly five-lined form, in which the dorsal

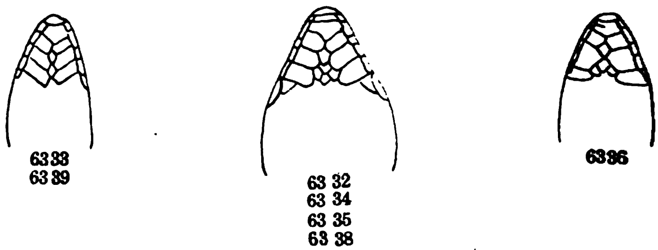


Fig. 4.—*Plestiodon quinquelineatus* Linn.

surface was nearly black, the ventral surface of the head and throat was usually tinged or mottled with blue, while in the older brown specimens with the brown dorsum and red head, the sides of the

than the irregular arrangement figured by Cope.[19] One specimen—the largest—agreed with Cope's specimen (No. 9,234, U. S. N. M.) in this respect. A variation was also noted in the plates of the mental region. Cope's figure (*ibid.*) shows two unpaired plates posterior to the mental. Of the specimens taken in the swamp, just half of the number collected conformed to this arrangement, while the other half showed only one unpaired plate between the mental and the first pair of inferior labials.

It can hardly escape the notice of the herpetologist that these peculiarities (the single postmental plate and the two occipital plates) here noted as variations of *P. quinquelineatus* are, except for the postnasal, among the chief structural characters usually given for the species *P. anthracinus* Baird, and the single or double postmental enters into Cope's four main divisions of the genus. Normally, one would expect two postmentals in *P. quinquelineatus*, and it so proves by examination of a large series of extra-Okefinokee specimens from other parts of southeastern United States, but this single postmental in the Okefinokee specimens is not limited to small forms, as are most of the supposed species with single postmentals. The largest red-headed specimen (No. 6,339) has this character, and another good-sized individual has only one postmental, but there is on one side of this plate the merest beginning of a suture to suggest where the subdivision might come if it were to be. We suppose Cope would be obliged to make these "postnasal—one postmental" specimens members of his first division, in which he places his Bermudan species, *E. longirostris*, but we could hardly grant such a solution, and this restricted collection of Okefinokee skinks prompts a doubt of the actual rank of *E. longirostris* and possibly of *E. anthracinus* and *E. pluvialis*, or, in other words, we have our specimens referable to two of Cope's four main groups for the genus, and if the postnasal character be proven variable this *P. quinquelineatus* may yet offer variants referable to the other two divisions. Certainly, the status of the species of *Plestiodon* is in a most unsatisfactory state at the present time.

The species *P. quinquelineatus* ranges through a wide series of coloration during life, particularly as pertains to the stripes and markings. The same bands appear in some specimens as are found in *P. anthracinus*, with a difference only in colors and brilliancy. Since the structural plate characters overlap, as has been noted

[19] Rept. U. S. Nat. Mus., 1898, p. 634, fig. 125.

above, the suggestion can hardly be avoided that if environment and climate be considered as affecting markings, it may lead to a reconsideration of the value of such a basis for specific distinctions.

An interesting illustration of regeneration was found in one of the specimens taken (No. 6,339) in which the tail had been injured 75 mm. from the vent and a new tail 65 mm. long regenerated. The old tail, however, still persisted, and projected at almost right angles to a distance of 10 mm. with a small shriveled stump on the end suggestive of a spine or barb.

Several of the specimens of *Plestiodon quinquelineatus* were infested with red mites (*Acarina*), which appeared attached under the fore legs. One individual had eight of these parasites under one fore leg and twelve under the other.

CROCODILIA.

16. **Alligator mississippiensis** Daudin. Plate II, fig. 1.

The alligator was found to be extremely common throughout the Okefinokee, and after the novelty of watching their interesting habits had worn off, no particular attention was paid to them by members of the party. Alligators were constantly being seen in all parts of the swamp, and a short trip in any direction from Billy's Island usually resulted in the noting of several specimens. Outside of a few shot for their skins and those killed for food, no adults were collected, as it would have been entirely impracticable to have transported their heavy bodies out of the swamp. A number of young were taken, and of these a half dozen or more were preserved.

A trip down Billy's Lake, from Billy's Island to Mixon's Hammock, was always the occasion for more or less sport in endeavoring to

distinguish them by the intervals, which are much shorter in the younger ones. Mr. Harper saw a five-foot alligator at the north edge of the swamp with his jaws tied with a cord which for several days it could not break. Later he observed that Bryant Lee could hold shut the two jaws of a wounded "gator."

Since these animals were found in every part of the swamp, no mention of particular localities is of importance. They were most abundant, perhaps, in Billy's Lake, in Floyd's Island and Honey Island Prairies and in the head waters of the Suwanee River. "'Gator holes," however, were to be seen in all waters deep enough to afford seclusion for the animals. These holes ranged in size from a few feet across to large areas extending from 25 to 75 yards in diameter. Throughout the swamp and in the prairies, also, were long open tracts in which no water-lilies grew, and these were pronounced by the natives to be "'gator trails."

The methods of hunting the alligator, as practised by the Lees and other inhabitants of the region, consist mainly of going out at night in small boats and locating the animals by means of a lamp fastened to the head of one hunter in the bow of the boat. Another hunter in the stern paddles or poles and uses the sharp end of the push pole to "stick" the body after the animal has been shot and has sunk to the bottom. According to these hunters, who every year take out a large number of skins, the eyes of the small alligators appear red by the light thus used, while those of the large specimens are yellow. The hunter carrying the light swings his head from side to side through an arc of 180 degrees, and when an alligator is sighted shoots it by the light of the lamp on his head. The common supposition that the skin of an alligator will turn the bullet of a gun is, of course, unfounded. Since, however, only the head of the animal is usually exposed when it is in the water, they are commonly shot through the eyes. The hunters generally use a shotgun loaded with buckshot. That a large number of alligators are annually secured in this manner is evidenced by the fact that the fields of the Lees are strewn with the skeletons and dorsal strips of skin which have been thrown away after each expedition. Only the ventral part of the skin is saved, the upper portions being too thick and spiny to admit of the primitive methods of tanning, and therefore the crest and dorsal scales are not retained.

Plenty of evidence was secured to prove that the alligator is a formidable antagonist when in the water. The powerful tail is the chief weapon of defence, and with it the animal can deal a terrific

blow. On June 13, 1912, a large-sized alligator was seen to slowly sink below the surface as several members of the party in a small boat were making a trip on Minne Lake. Bryant Lee "grunted" the animal to the surface, where it was shot, but not killed. It rose within a foot or two of the boat and performed a most remarkable series of spinning movements, revolving rapidly on its tail with its body directly upright and the head out of the water. Several shots and repeated blows of the paddle were required before it finally sank.

The alligators of the Okefinokee showed no variation, so far as our observations went, from the ordinary form of *A. mississippiensis*, which has been sufficiently well described by various authors to make a description in this record unnecessary. The young which were preserved agree also with the published descriptions and are most brilliantly marked in the smaller specimens. As the animal increases in age, the fifteen transverse yellow bands become fainter and the dorsal crest more pronounced. In the very young specimens the dorsal tubercles of the neck are entirely absent.

No nests of eggs were found, but a number of eggs were taken from the bodies of those killed. In one specimen (No. 6,493) were found twenty mature eggs, ready for depositing. These eggs have completely formed shells which are thin and soft, not brittle, and grayish-white in color, with a granular coating which rubs off on handling. The average length of these eggs is 3 inches and the average diameter $1\frac{5}{8}$ inches. From a female $8\frac{1}{2}$ feet long, taken on Billy's Lake, June 11, 1912, were taken 42 embryonic eggs ranging in size from $\frac{1}{4}$ to $1\frac{3}{4}$ inches in diameter, almost spherical and of a dark orange color. The skin of these eggs is soft and smooth and

animals have been seen in its waters and are still occasionally to be encountered, although the evidence offered is very meagre and the descriptions given of the so-called crocodiles are far from satisfactory.

The natives describe the crocodile as being much darker in color than the alligator and state that in the crocodile the upper jaw is movable instead of the lower. This latter notion, it may be observed, is common throughout this part of the country, and is insisted upon by many hunters, although the basis for the idea is not evident. On the other hand, the chief points of scientific distinction between the two animals is never touched upon by those who profess to have seen the crocodile, and even such striking differences as the longer snout and the more active movements of the latter animal appear never to have been noticed.

Bryant Lee states that crocodiles have been taken in the region around Cow House, but that he has never seen one south of Honey Island. Joe Saunders insists that he has seen crocodiles in a creek flowing into the Suwanee River in Clinch County, while Jackson Lee says that he knows of at least two crocodiles being taken in Billy's Lake. These hunters, when pressed for details, state that the chief distinctive character of the crocodile is the *color of its eyes*, which they describe as red or orange, and the much darker color of the body.

These men have spent their lives in the swamp and are remarkably close observers, and it is evident that the form which they have in mind is in some way different from the common alligator, but it seems unlikely that it is *Crocodilus americanus.*

II. SNAKES.

BY A. H. WRIGHT AND S. C. BISHOP.

No State in the United States has furnished more distinctive and peculiar snakes and no area has received more herpetological attention than Florida, yet none of these numerous ophidian collectors and students has ever entered Okefinokee at Florida's northern border. The nearest approach came about twenty-five years ago in the visit of the ornithologist, Mr. C. F. Batchelder, of Cambridge, Mass. He spent a day or two on Mitchell and Black Jack Islands. To the eastward, at St. Mary's, Ga., and at Fernandina, Fla., he took the following species:

Cyclophis æstivus, *Osceola doliata doliata,*
Osceola elapsoidea, *Ophibolus getulus getulus.*

In Florida, at Gainesville, the snakes secured by James Bell in

1879, July, 1880, and April 7–18, 1882, prove most instructive, for this locality is not far south of Bay Swamp, the Floridan extension of the Okefinokee Swamp. Mr. Bell has the following list:

Abastor erythrogrammus,*
Farancia abacura,
Heterodon platyrhinus,
Heterodon simus,*
Cyclophis æstivus,
Zamenis constrictor,
Zamenis flagellum,*
Coluber quadrivittatus,
Compsosoma corais couperii,*
Pityophis melanoleucus,*
Osceola doliata parallela,
Osceola elapsoidea,
Ophibolus getulus getulus,
Natrix fasciata fasciata,
Natrix fasciata pictiventris,
Natrix fasciata sipedon,
Natrix fasciata erythrogaster,
Eutænia sackenii,
Elaps fulvius,*
Ancistrodon contortrix,*
Crotalus adamanteus.

Of the above 22 species, seven (with asterisks) are not in our list. All of these seven we might expect in southeastern Georgia, and were in our working hypothetical list before the trip was taken. They represent the remaining Austroriparian forms which were not taken by us, and with the truly Floridan peninsular snakes almost complete the whole list of southeastern United States forms. Furthermore, these seven (with *Abastor erythrogrammus*, a mud and aquatic snake eliminated from consideration) represent the assemblage of southeastern species which most prefer the dry pine forests of the Atlantic coast or dry open or sandy fields where the gopher turtle occurs. We have no doubt that these seven occur on the Atlantic seaboard to the immediate east of Okefinokee and also in its outskirts. In fact, the natives held that there were several kinds of snakes outside the swamp which were not within it, and, among these, they named the coachwhip snake. Besides, the

In the earlier days, Holbrook received some material from the region to the eastward of the swamp (*vide Tropidonotus taxispilotus*).[20] In another place (Vol. IV, p. vi), he writes: "J. Hamilton Couper, Esq., of St. Simon's Island, Georgia, has also furnished me with several Serpents of that state; and to him I owe a knowledge of the Gopher Snake, perhaps the largest and most beautiful of our Serpents." Of this form, Mr. Couper says:[21] "I have only seen it in the dry pine hills, south of the Alatamaha; and I have never met with it in the low grounds even of the same vicinity." This may explain its absence in the Okefinokee. In this connection, it is interesting to observe that the same seven absent forms (except *Compsosoma corais couperii*) occur in Dr. Holbrook's Catalogue[22] of the Ophidia of Georgia. In it 33 species of snakes are listed. In C. S. Brimley's[23] *Records of Some Reptiles and Batrachians from the Southeastern United States* we find 21 species recorded from Georgia. Five (*Compsosoma corais couperii* and *Abastor erythrogrammus* being absent) of the seven species missing from Okefinokee are given in his list as taken either at Riceboro to the northeast or at Mimsville to the west.

In 1871 and 1876, Paul Fountain visited this area and he writes:[24] "I can assure the lover of Nature, if he is prepared to run the risk of fever, that the farther he forces his way into its gloomy depths, the more remarkable and beautiful will be the forms of animal and vegetable life he will discover." Later he says: "A greater number of reptiles may be found in this swamp than in any other spot I know of in the States." And he reserves his discussion and digression on snakes in general for his chapter on *A Day in a Cypress Swamp* (Okefinokee).

In 1888, Cope published *On the Snakes of Florida*,[25] and this paper has considerable bearing on some of the Okefinokee species; but, inasmuch as it is embraced in Cope's great work,[26] *The Crocodilians, Lizards, and Snakes of North America*, we will not consider it in detail. In 1896, the next list of some pertinence is *Remarks on Some of the Floridan Snakes*, by Charles B. Cory.[27] He enumerates 15 of the commoner species of this State.

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[20] N. A. Herpetology, 1842, Vol. IV, p. 36.
[21] N. A. Herp., Vol. III, pp. 76, 77.
[22] White's Statistics of the State of Georgia, 1849, Appendix, p. 14.
[23] Biol. Soc. Wash., 1910, Vol. XXIII, pp. 8–18.
[24] Fountain, Paul. The Great Deserts and Forests of North America, New York, 1901, pp. 65, 66.
[25] Proc. U. S. Nat. Mus., Vol. XI, pp. 381–394.
[26] Rep. U. S. Nat. Mus., 1898, Washington, 1900, pp. 153–1270.
[27] Hunting and Fishing in Florida, Boston, 1896, pp. 124–131.

From September, 1892, to July, 1893, Prof. Einar Loennberg,[23] of University of Upsala, Sweden, was engaged in collecting in Florida and his *Notes, etc.*, published in 1895, proves one of the most important herpetological papers on southeastern United States in the last quarter of a century. He secured 30 species of snakes. Nine of his 30 species are not represented in our collections, three being genera peculiar to Florida, one, *Tantilla coronata*, occurring in Georgia as well, not being recorded, however, from the Okefinokee Swamp, and five proving of the same assemblage as Bell's seven (Gainesville) species missing from the Okefinokee Swamp, because they are more especially dry pine land forms.

The 21 species taken in the swamp represent a distinctly Austroriparian element which does not entirely shun moisture. The collection of 165 individuals apportioned numerically among the 21 different species of snakes indicates very roughly the degree of abundance on Billy's Island or its immediate environs. The list follows:

Heterodon platyrhinus	38	*Elaphe obsoletus*	6
Ancistrodon piscivorus	16	*Opheodrys æstivus*	5
Thamnophis sirtalis ordinatus	15	*Farancia abacura*	3
Coluber constrictor	13	*Diadophis punctatus*	3
Lampropeltis getulus	13	*Crotalus horridus*	2
Tropidonotus taxispilotus	11	*Elaphe guttatus*	2
Thamnophis s. sackeni	10	*Storeria dekayi*	2
Tropidonotus fasciatus	10	*Storeria occipitomaculata*	1
Lampropeltis doliatus coccineus	6	*Cemophora coccinea*	1
Sistrurus miliarius	6	*Crotalus adamanteus*	1
		Haldea striatula	1

None of Cope's (1900, p. 1207) four peculiar snake genera (*Stilosoma*, *Seminatrix*, *Rhadinea* and *Liodytes*) of the Floridan region enter the

Profs. J. C. Bradley and C. R. Crosby, of the Department of Entomology; Dr. A. H. Wright, of the Department of Zoology; Headmaster W. D. Funkhouser, of the Ithaca High School; Messrs. S. C. Bishop and M. D. Leonard, of the class of 1913, and Paul Battle, of Bainbridge, Ga. During the first week, Mr. E. L. Worsham, State Entomologist of Georgia, and Mr. C. S. Spooner, Assistant State Entomologist, were also with the party. Later, from July 15 to November 1, 1912, the Lees judiciously collected material which added four species to our list and nicely augmented our series of previously known forms. In the fall of 1913, Prof. J. C. Bradley and Paul Battle spent a week on Billy's Island and brought out a few reptiles. In December, 1913, Profs. J. G. Needham and J. C. Bradley, Messrs. John Needham and Paul Battle made a trip of ten days into the Okefinokee and collected considerable data on the winter conditions. Some of their material they brought out, but they left a container which was filled by the Lees by August 1, 1914. This collection has not been received and is not incorporated in this report. All the members of these various parties and, particularly Prof. Bradley, collected snake material and data and, to each of them we are deeply indebted for aid, good communal spirit and material encouragement. Acknowledgments are due Dr. Leonhard Stejneger, of the United States National Museum; Dr. Witmer Stone and Mr. H. W. Fowler, of the Academy of Natural Sciences of Philadelphia, for the privilege of examining types in their respective collections, and to Messrs. R. W. Bennett and Cornelius, of Fargo, Ga., without whose courteous assistance it would have been impossible to have transported our material out of the swamp.

The Lees proved very efficient collectors. They enjoy life in this naturalist's paradise and do not live in constant fear of the numerous venomous snakes and dangerous animals of the swamp. They do not alter their course in life because of them, though they respect and appreciate the danger and know what bad wounds some can inflict. They bathe in the lakes where many accidents might befall them, but usually do not. The children go barefoot and were our best and most vigilant scouts about the Lees' clearing. Many a snake, both large and small, they "stepped on," if they did not "cromb" it with a stick. They knew not the noose, and to it we had little recourse except on rare occasions. The gun proved very serviceable in the thickets. The Lees' fields and clearing were the resort of turtles, lizards and oviparous snakes which sought them for breeding purposes.

Hither, as in other parts of the swamp, the bears, raccoons, opossums and other mammals come for the eggs buried in the sand. Over this same ground the king snake, black snake and pilot snake search for the same quarry and the reptiles which lay the eggs. The natives have a very good idea of the economic value of the various snakes and spare most of them, except the truly poisonous forms and what they call the "Water" and "Highland Moccasins" (*Tropidonotus* and *Thamnophis*). One of the many rôles which the natives accredit the black and turkey vultures is that of enemies of snakes and some birds of prey, *e.g.*, the Buteos engage in the same practice. The snakes also suffer from the herons, ibises and cranes, but with these the reptiles are a second choice when frogs and toads are available.

The number of snakes with internal parasites is surprisingly large, 37 of the 165 being thus afflicted, or 8 of the 21 species. They are:

Heterodon platyrhinus	14	*Thamnophis s. sackeni*	2
Ancistrodon piscivorus	6	*Lampropeltis getulus*	1
Coluber constrictor	5	*Sistrurus miliarius*	1
Tropidonotus taxispilotus	5		
Thamnophis s. ordinatus	3		37

No doubt, other species also suffer, for this list represents the species of which we had the largest series. The above species are about equally distributed between the terrestrial and aquatic groups. In number, the former are 24 and the latter 13; but, if the spreading adder be eliminated, the terrestrial forms lead by 3. It is a significant fact that the species which are the worst sufferers are also inveterate [redacted]

Cypress Bays.

Ancistrodon piscivorus,
Farancia abacura,
Thamnophis s. sackeni,
Tropidonotus taxispilotus,
Tropidonotus fasciatus.

Prairies.

Thamnophis s. sackeni,
Tropidonotus fasciatus.

Water Courses.

Ancistrodon piscivorus,
Tropidonotus taxispilotus,
Elaphe obsoletus.

Transition Zone Between Islands and Cypress Bays.

Farancia abacura,
Heterodon platyrhinus,
Crotalus adamanteus,
Coluber obsoletus,
Diadophis punctatus,
Storeria dekayi,
Haldea striatula.

If these snakes be considered from the point of view of locomotion, they fall into the same four groups which Loennberg (1895, pp. 336, 337) made, and the snakes are quite similarly, but not absolutely, arranged as he found them:

Swimming Forms.

T. taxispilotus,
T. fasciatus,
T. s. sackeni,
A. piscivorus,
F. abacura.

Burrowing Forms.

H. platyrhinus,
F. abacura,
L. d. coccineus,
L. getulus.

Crawling Forms.

T. s. ordinatus,
C. constrictor,
L. getulus,
L. d. coccineus,
S. miliarius,
C. adamanteus,
C. horridus,
E. obsoletus,
D. punctatus,
E. guttatus,
S. dekayi,
S. occipitomaculata,
H. striatula.

Climbing Forms.

E. obsoletus,
E. guttatus,
O. æstivus,
C. constrictor,
L. d. coccineus.

Or, viewed from the standpoint of breeding, they are about equally divided: the poisonous snakes, *Tropidonotus*, *Thamnophis*, *Storeria* and *Haldea*, being ovoviviparous, and all the rest oviparous.

Finally, if the Okefinokee snakes be grouped according to food, based largely on stomach contents, but also on observations of the haunt, time of activity in the swamp and on the keen knowledge of the natives, these snakes are arranged as follows:

MAMMALS, BIRDS OR THEIR EGGS.

E. obsoletus,
L. getulus,
C. constrictor,
S. miliarius,
C. adamanteus,
C. horridus,
A. piscivorus,
E. guttatus (*mammals only*.)

LIZARDS (OR THEIR EGGS).

C. constrictor,
S. miliarius,
L. d. coccineus,
L. getulus,
(*C. coccinea*).

FISH.

T. s. sackeni,
T. taxispilotus,
(*T. fasciatus*),
A. piscivorus,
L. d. coccineus.

TURTLES (OR THEIR EGGS).

L. getulus,
A. piscivorus,
E. obsoletus.

FROGS.

only one of the larger snakes being in this category. Doubtless, all the 21 species will eat insects to a certain extent. The species which are almost exclusive insect feeders are *Haldea striatula*, *Storeria occipitomaculata*, *Storeria dekayi* and *Opheodrys æstivus*. The reader must bear in mind throughout this discussion we are treating Okefinokee snakes and not the species throughout its entire range.

With the larger snakes, the food most generally sought is Anura or Amphibia in general. It is *par excellence* the food of the aquatic snakes, and with these four or five species it usually is some species of *Rana*, though *Acris*, *Chorophilus* or *Hyla* may rarely appear as their prey. Equally important are frogs in the food of the larger land snakes, 5 species being addicted to them. With these the southern and oak toads (*Bufo*) are easily of first importance, with the tree frogs (*Hyla*) and the narrow-mouthed frog (*Engystoma*) occupying second and third places. In fact, these 10 snakes prefer the soft-bodied frogs and toads to any other food of the swamp (reptilian eggs not considered), and if they were to be restricted to any one of these categories they belong to this group.

Fish enter into the food economy of all the aquatic species, the bream and killifishes proving the common bait. *L. d. coccineus* ate fish, as doubtless some of the island forms do when the smaller fish become cut off in landlocked pools on the islands.

In general, the lizards are swift (except the ground lizard), and fall prey only to some of the swifter coursers of the islands. However, at least 5 species ate them or their eggs. The turtles when young and soft are occasionally taken by the moccasins and possibly by the other aquatic snakes, the young soft-shelled turtles (*Platypeltis ferox*) being the species most attacked. On the land, the turtles' eggs are eaten by at least 2 species, if not by many more. This source of food is one of the commonest of the swamp for man, mammals and snakes. At least one-third of the species are cannibalistic and will eat snakes, either adults or young, or eggs.

The warm-blooded groups, birds and mammals, suffer from the same foes. Seven species of the largest snakes of the swamp assail them, their eggs or young. Four of these seven are the four poisonous snakes of the swamp, while the other three are the pilot, black and king snakes. In addition, the mammals have an inveterate foe in the corn snake, which apparently does not molest birds. None of these seven or eight species are aquatic but one, the moccasin.

The three omnivorous coursers on the islands are the king snake, pilot snake and the black snake, while in the water the only snake

which includes insects in its diet to any extent is the southern riband snake. One must be impressed with the immense abundance of the reptilian forms, the restricted island quarters for these reptiles and the need of great numbers to keep each species existent under such strenuous vicissitudes. Each form, fish, amphibian, reptile, bird or mammal, has untold foes which are close at hand, fellow-travellers of the same course and seekers of the same breeding grounds already crowded. Never have we been so struck with the incessant warfare of primeval nature as on these islands of the Okefinokee.

Another very interesting fact is the isolated nature of the place where these 165 snakes were taken. They are virtually a collection of Billy's Island ophidians with a few other islands and portions of the swamp represented. Our series of each species becomes, therefore, very significant if several variants appear. They cannot be designated as geographical subspecies or varieties and must be considered only as indicating the inherent range of variation which a species may manifest in one limited geographical region, not what might appear in an extensive or expansive stretch of territory. Hence, the value of the material, though not as numerous as might be desired.

Without doubt, many of the conclusions and observations in this paper are not new and are only corroborative of previous work, but they may have interest because of their independent nature. The more significant conclusions are:

1. That *Tropidonotus fasciatus* and most of its subspecies, *T. compressicaudus*, *T. ustus*, *T. bisectus* and *T. rhombifera*, need to be restudied before they can be finally accepted.

[redacted]

as those with the typical red ventral coloration, and that this albinistic character is not solely an adult or young variation.

8. That our specimens of *Heterodon platyrhinus* are one-third *platyrhinus*, one-third intermediate and one-third *niger*; that possibly *niger* is an adult end phase, and that one *platyrhinus* specimen agrees perfectly with *Heterodon brownii* Stejneger, both in the absence of the azygous plate and in coloration.

9. That the two specimens of *Storeria dekayi* have not 17, but 15 rows of scales, like *S. occipitomaculata*, and one of the two specimens has the oculars not 1–2, but 2–2, as usual in the red-bellied species, the lone representative of which has the ocular formula 3–2.

10. That the range of the southern ribbon snake, *T. s. sackeni*, is not restricted on the Atlantic coast to Florida.

11. That *C. horridus* of the Okefinokee is distinctly the light canebrake form of this species.

1. **Farancia abacura** (Holbrook): Horn Snake; Red-bellied Snake; Hoop Snake; Rainbow Snake; Mud Snake; Checkered Snake.

Three specimens were taken, and from native accounts it apparently is fairly common, but hard to secure. In distribution this species reaches from Virginia to Florida and from Indiana and Illinois to Louisiana and rarely into Texas. The nearest records are from Allapaha, Ga., to the northwest, and from Gainesville, Fla., to the direct south.

Coloration.—The horn snake is one of the most beautiful snakes of North America. The ground color is a blue-black, the smooth and shining scales have an enamelled surface, and the gastrosteges and the scales along the sides have a fluted appearance. Every labial, mental and gular plate has a blue-black spot in its middle. The color of the back extends to the gastrosteges in vertical bars or inverted triangles, the apices being on the gastrosteges. Usually, at each one of these apices appears an oblong spot, and in the cephalic half of the body, the venter, as a result, presents a row of these spots on either end of the gastrosteges, thus giving a distinct light-colored band down the middle. In the caudal half of the body the vertical bars of opposite sides usually meet or alternate on the mid-ventral line, producing a checkered appearance. The vertical black bars are two scales wide at the end of the gastrosteges and three or four scales wide on the 4th row of scales. The lighter intervals between the dark bars are two scales wide at the end of the gastrosteges and one wide at the 4th row of scales. Each gular gastrostege has a black band across it.

The lighter color of the venter extends to the 4th row of scales in the younger specimens. In these, usually at the neck of the light interval, there appears one or two blue-black spots to suggest the almost complete invasion of the body color upon these areas in the large specimens where the light areas seldom reach the 2d row of scales and where there are large central black spots on the scales. Our specimens have 63, 64 and 65 light vertical bars or wedges, respectively, or from 50–53 from the anus forward. Curiously enough, the two specimens which we first took alive, one 151.7 cm. long and the other 43 cm., were *white beneath, and not red.* The other preserved specimen has also the whitish appearance. Two of the specimens in alcohol may possibly have a slight tinge of pinkish, but it is faint if present at all; surely, it is *not yellow.* These three white-bellied *Farancias* are noteworthy. H. H. Brimley[29] took a large white-bellied adult male, which was coiled with a normal male and female *in coitu,* but our specimens, however, are not all adults, one being only 43 cm., the largest, 151.7 cm., and another intermediate 81.1 cm. The native present when we caught the largest specimen asserted that he had seen red-bellied forms of this snake, and, in December, 1913, Profs. Needham and Bradley saw a beautiful red-bellied individual of this species.

Dimensions and Variations.—The gastrosteges were 194, 195 and 196, respectively, in our three specimens; the urosteges, 39, 39, 42; the scales 19–19–19; supralabials 7; eye over 3d and 4th supralabial; infralabials 8; loreal elongate; temporals 1–2; nasal with groove below nostril; in C. U., No. 6,108, a groove above the nostril as well; anal plate and the gastrostege before it divided; in the caudal half of the body 6 or 8 rows of scales on the dorsum with a suggestion

into it. Our first hold of this snake was not secure and it as quickly began burrowing the second time. From all that we observed of the living snakes of this species we would consider them timid, harmless burrowers. They are decidedly inhabitants of the twilight parts of the swamp, and their eyes suggest such a habitat. If found during the day, they appear in the dark, gloomy cypress ponds on the islands or amongst the dense vegetation of the deepest and most inaccessible regions of the swamp. We discovered no particular superstitions regarding its horny tip. It is curious to find the hill hoop-rolling story also associated with this species, which to my mind is one of our most aquatic species, and the names "cypress" or "sphagnum" snake would be equally appropriate with some of the names suggested by its structures.

Food and Breeding.—None of the specimens had food in their alimentary tract and no parasites were found. The natives relate how the thunder snake (*L. getulus*) digs beneath rotten logs and other cover for the adults and young of this species. Of the breeding habits of this oviparous form we know little. The natives assert that the progeny of one female sometimes reaches 40 to 43.

3. Diadophis punctatus (Linnæus): Ring-necked Snake. Plate III, fig. 1. Fig. 5.

This species is probably fairly common on the islands of the swamp. Three specimens were secured on Billy's Island between June 11 and 15, 1912.

Coloration.—All three specimens are bluish-black or brown above, the color extending on to the end of each gastrostege. These black spots on either extremity appear as a row on each side of the venter. In No. 6,105 they are very obscure on the neck region. In all three the dorsal scales are with pale edges and with numerous fine light specks. In No. 6,104 the edges of the dorsal scales are opalescent. In No. 6,106 there is a median row of body-colored spots down the venter to the anus, all the urosteges and gastrostege No. 2 being without spots; the same applies to No. 6,105 with the urosteges and gastrosteges Nos. 1–5, 8 unspotted; in No. 6,104, the median row is very interrupted, no spots being on gastrosteges Nos. 1–20, except No. 3, and none beyond No. 133, while between Nos. 21–133 there are several missing. In No. 6,105, the nuchal half collar is 1–2 scales wide; in No. 6,106 it is the same width, but interrupted by a median dorsal row of black scales, while in No. 6,104 it is faint except on the lower sides. In No. 6,105, the mental and labial regions are almost immaculate, a few infralabials being with faint black spots; in No. 6,104, each infralabial is well marked with one

or more black spots as the symphyseal is; in No. 6,106, the geneials as well have these spots.

Dimensions and Variations.—The total length of these three snakes reaches from 19.5–29 cm.; the tail from 4.7–5.8 cm. or $4\frac{1}{7}$–$5\frac{1}{4}$ in the total length; the gastrosteges are 143–150; the urosteges, 39–46; anal divided, and in one the gastrostege ahead is also divided. Tail very spike-like and sharp. Scales 15–15–15; temporals 1–1; oculars 1–2 in No. 6,106, the preocular large on the right side and small on the left side, the prefrontal taking the place of the normal upper preocular, 2–2, in Nos. 6,104 and 6,105. The supralabials in No. 6,106 are 8, with the eye resting on the 4th and 5th; in No. 6,105 on the right side they are 8, with eye on the 4th and 5th, while on the left side there are 7, with the eye on the 3d and 4th; in No. 6,104 there are 7 supralabials on each side, the eye being over the 3d and 4th on each side. In Nos. 6,105, 6,106 the supralabials have the clear band of ventral color, but in No. 6,104 this color is heavily encroached upon by black.

6105 6105 6106 6106

Fig. 5.—*Diadophis punctatus* (Linn.)

In view of Cope's establishment of *D. amabilis stictogenys* upon three specimens from New Orleans, Pearl River, Miss., and Savannah, Ga., the last locality not far from Okefinokee Swamp, our three specimens prove interesting. To find these three showing such a gamut of differences is rather fortunate. Our specimen No. 6,104

concurrence (study of *Diadophis* in manuscript)—all force the authors to consider this subspecies untenable. .

Habits.—This attractive snake was found during the day under cover, usually under logs near the cypress edges of Billy's Island. It seemed to prefer localities near the edge of the thicker woods. In one case it was under a log in a place near and exactly similar to the situation described for *Haldea striatula.* In the other instance, the two were taken (June 11, 1912) under a log near Billy's Island landing at the woody edge of cultivated fields. The *D. a. stictogenys* specimen was first taken and a few minutes later the other specimen was found under the same log. The former may have been seeking the sandy fields of the Lees where lizards, snakes and turtles resort in great numbers to lay their eggs. This specimen had six unlaid eggs which measured as follows: 18 x 9 mm., 19 x 9, 19 x 9, 20 x 9, 20 x 9, 21 x 10. The covering is thin and quite pinkish in alcohol. This species seems as nocturnal in Okefinokee as our experiences with it elsewhere suggest. These specimens had insect and worm remains in their alimentary tracts.

8. **Heterodon platyrhinus** Latreille: Hog-nosed Snake; Hog-nose; Spreading Adder; Spreading Viper; Blowing Adder; Blow Snake; Blowing Viper; Spotted Adder; Flatheaded Adder; Puff Adder; Sand Viper; Black Viper. Plate III, fig. 7; fig. 6.

Thirty-eight specimens were secured, of which 16 were young snakes; one was a cast skin.

Coloration.—In coloration our series show all possible patterns. The 16 young were all of the spotted phase and manifested the following pattern: The ground color may be yellowish, brownish or reddish. Down the back is a series of 26–32 spots and on the tail 7–9 spots which become transverse bands. The color around these dorsal spots is brighter or lighter than the surrounding body color. Alternating with and almost touching the corners of the dorsal spots is a series of lateral spots. In the cephalic region, one of these spots of each side with a pair of successive dorsal spots form a quartette—an arrangement soon lost in the caudal part of the body and seldom seen in adults. Beneath these spots may be seen one or more series of small spots, not very distinct in form. The venter is grayish or greenish-white, heavily blotched with black or brownish. The head has a black bar connecting the upper anterior edges of the orbits; another bar from the eye to the angle of the mouth; and a third, on occipital plates, posterior margins of supraorbitals and frontal. This black spot has a backward extension on either side of the nape or neck and usually a small median extension

just back of the occipital plates. Often this median prolongation is cut off and surrounded by body color. Usually on the occipital suture and occipitofrontal suture appears a light spot.

In some of the adults the same schema of coloration obtains as in the young, except that dorsal and lateral spots are less distinct as such and become more transverse areas with light intervals. Furthermore, the supralabials are more prominently spotted in the young.

Of the 21 specimens of adults, 8 were of the black (*niger*) type with slaty-gray below. In most of these 8 the gular scales and whole chin except in two become the darkest portion of the whole venter. Of the spotted forms (*platyrhinus*), we had a few with the brick-red on the head and neck and somewhat on the body. In the intermediates, the approach to the black phase begins in the head region and the head first becomes black, or it and the neighboring cephalic region. In this process the transverse light intervals remain brightest and persist longest in the tail region. Some of the specimens are almost *niger* in the cephalic region, but ***platyrhinus*** in the caudal half, or three-quarters *niger* with the scales of the light intervals of the caudal region with incoming black centres. About 7 of the adults were true spotted adders and 6 intermediate. Thus, of the adults we have an almost equal division of 7 spotted, 6 intermediates and 8 blacks. Most of our largest specimens were black or fast approaching that stage. The black seems to be an end phase of size or age, possibly not always attained in an individual, but certainly the spotted phase is most prominent in the smaller specimens of the collection. Besides, it might be remembered that none of the 16 young were black, but all true spotted forms.

25 rows of *Heterodon platyrhinus* and *simus*. The temporals are 3–4 on both sides in twenty-seven specimens, 3–4 on one side and 3–5 on the other in three specimens, and 3–4 and 4–5 in one specimen; the supralabials are 8 in twenty-seven specimens, 9 in seven specimens and 9–8 in three specimens; the infralabials are 11 in fifteen specimens, 10 in three specimens, 12 in five, 13 in one, 10–11 in four, 10–12 in three, 11–12 in five and 12–13 in one. The orbital ring exclusive of the supraocular is 10 on both sides in thirteen specimens, 11 in one, 9–10 in two, 9–11 in two, 10–11 in fourteen, and 8–10 in two, *i.e.*, 22 of the 38 with number of oculars different on the two sides.

Rarely, the azygous plate may be cut off from contact with the rostral by the prenasals (No. 6,186). One spotted specimen (No.

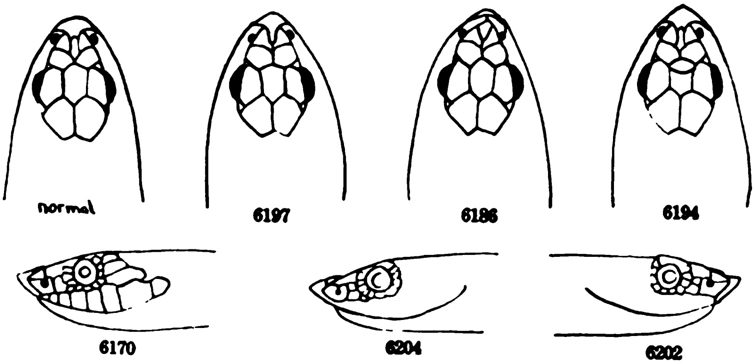


Fig. 6.—*Heterodon platyrhinus* Latr.

6,197) has not the characteristic azygous plate at all. Unlike Dr. Stejneger's *Heterodon browni*,[30] this specimen has the posterior projection of the rostral more than one-half of the suture between the internasals and their mutual suture, therefore less than that between the prefrontals. Otherwise, it is very much like it. The specimen has the following scutellation: gastrosteges, 123; urosteges, 55; anal divided; scales 25–21–19; supralabials 8; infralabials 11; orbital ring 10, not including the supraocular; temporals 3–5 on the right side and 3–4 on the left side. These characters and a very similar coloration bring it in almost perfect agreement with Dr. Stejneger's *H. browni* from the other end of Florida, namely, Lemon City. A black individual (No. 6,194) has the frontal transversely divided into two plates. One specimen (No. 6,202) has 2 loreals on either

[30] Proc. Biol. Soc. Wash., XVI, pp. 123, 124.

side, and two others (Nos. 6,178 and 6,205), both small individuals, have 2 loreals on one side and 1 on the other. Another (No. 6,204) has 2 loreals on one side and 3 on the other, if an extra scale between the oculars, loreals and 3d and 4th supralabials be called a loreal. This small extra scale also occurs in No. 6,170.

Habits.—This interesting snake proved very common around the Lee's sandy clearing and in all dry parts of the swamp. It was the first form to be observed and of it more specimens were taken than of any other species. One might find it beside the trails or on the islands where no human courses led. They were often taken about and in the corn, "chufa," "goober" and "yam" fields of the Lees, where the snakes probably resort for breeding. Here it did not seem to be solely a case of light-spotted phase for dry and sandy places and dark phase in more woody and moist situations. In the same open fields we find one phase one day and the other the following day. In two instances we took adult spotted and black phases within 40 feet of each other. We dare not make a distinction between the two as to habitat, sex, food, etc., unless it be size or age. In this case, often the oldest ones are not always black or blackish, but they seem to tend that way. Of its "spreading" or flattening we saw evidences, and the natives are well aware of the assorted defensive repertoire of this curious snake. They had none of the superstitions about the emanations from it affecting the atmosphere, nor did they believe that it "spat" its poison when hissing. In all our captures we saw no particular signs of ill temper.

Breeding.—This snake is oviparous. All through the month of June we were finding the snakes in the planted fields of the Lees and more than once almost stepped on the clumsy females of this species.

the granules of the latter. These 42 eggs average $1\frac{3}{16}$ (30 mm.) x $\frac{13}{16}$ (21 mm.) inches and are not far advanced in development.

Food.—We can hardly hold that the black forms eat frogs and toads and that the light ones will refuse frogs. Of course, if one grants the more moist situations for the dark phase, such a differentiation of diet preference might possibly occur. Our specimens preferred toads. Three had each a southern toad (*Bufo lentiginosus lentiginosus*) in their stomachs. Another had eaten three southern toads, two full grown and one half grown. Three had partaken of beetles and two had taken grasshoppers.

Parasites.—Fourteen of the 21 adults had parasites in their stomachs or intestines. Sometimes the sole contents of the alimentary tract might be a bundle of parasites; in individual cases the stomach would be absolutely filled with them. No snake compares with the spreading adder as a host for these animals, and it may be due largely to its strong Anuran diet.

4. Opheodrys æstivus (Linnæus): Green Snake; Southern Green Snake; Keeled Green Snake; Rough Green Snake; Green Whip Snake; Magnolia Snake; Summer Snake; Green Summer Snake. Fig. 7

Three specimens of this species were secured from Billy's Island, on June 5, 1912, and the other two from July 15–November 1, 1912.

Coloration.—This species is bright green above and usually yellowish-white below and on the labials. In two of our specimens the green of the back extends across the caudal two-thirds of each gastrostege, but the chin and the labials are more or less yellowish-white.

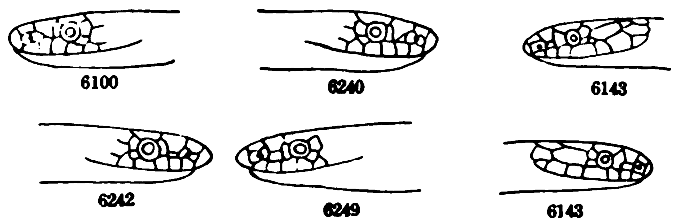


Fig. 7.—Left and middle figures *Lampropeltis doliatus coccineus.* Right-hand figures *Opheodrys æstivus* (Linn.)

Dimensions and Variations.—The total length varies from 31.2–68.1 cm.; the tail, from 12.0–26.7 cm., or 2.5–2.6 times in the total length; the gastrosteges are from 151–160; the urosteges, 130–148; anal divided, in No. 6,233, the ventral plate ahead divided and one of the halves also horizontally subdivided; scales 17-17-15; loreal

present; oculars 1–2, in No. 6,143 caudad of the lower postocular is a small scale hardly a temporal; if this be not a temporal, the temporal formula for all three is 1–2; infralabials 8, the fifth largest; supralabials 8 in one specimen and 7 in the other two, eye resting on the 3d and 4th supralabial; scales 17–17–15, the lower row smooth, the second row very faintly keeled.

Habits, Food.—In our experience this species is decidedly arboreal, and Profs. Crosby and Bradley record the same habitat for it. The specimens were taken from small bushes, and it is a close second to *Elaphe obsoletus* and its allies in its tree-climbing proclivities as the records and its long, slender body testify. This species is quite thoroughly insectivorous, one specimen having undeterminable insect remains in the rectum; another, a partly digested beetle larva, and the largest, parts of a tree cricket and other orthopterous remains with insect eggs presumably belonging to the prey captured.

5. Coluber constrictor L.: Black Snake; Black Racer; Racer; Black Runner; Blue Racer; White-throated Racer. Plate III, fig. 5; fig. 8.

This slender snake was one of the most common species of the islands, but only thirteen of them were captured because of their speed.

Coloration.—In coloration this smooth-scaled snake is shining black above and slaty or plumbeous beneath; the white chin and throat in most of the specimens occupy the mental, infralabials, genecials, first 2–3 gular gastrosteges, the cephalic gulars and the lower edges of the supralabials; two or three of the larger specimens have slaty chins except for a small white spot, which in one case covers parts of the mental, inner border of the 1st and 2d infralabials and the anterior geneials, while in the other it occupies 1st gastro-

stege is cut out of it; in eleven of the thirteen specimens the scales are in 17–17–15 rows; in No. 6,206, 19–17–15, and in No. 6,207, 19–15–15; preoculars 2, the upper one often with a transverse furrow extending across it for $\frac{1}{2}$ to $\frac{1}{3}$ of its width; postoculars 2, except in No. 6,152, where 3 are on the left side; temporals 2–2–2, rarely 3–3–3, or 3–2–2, or 1–1–2; infralabials 8, in four specimens 9 on one side; loreal 1, but in No. 6,157 there are two, the upper one being cut off from the prefrontal; rarely the postnasal is transversely divided; supralabials 7, in No. 6,154 there are only 6 on the left side, the normal 5th and 6th having united; in Nos. 6,150 and 6,156 8 supralabials are on both sides, while in No. 6,151 there are 8 on one side and 7 on the other; whenever eight supralabials occur, the eye rests on the 4th and 5th supralabials, not on the 3d and 4th. This eight supralabial condition Cope thinks rather peculiar to the Plains (*flaviventris*) or Pacific (*vetustum*) forms of *C. constrictor*.

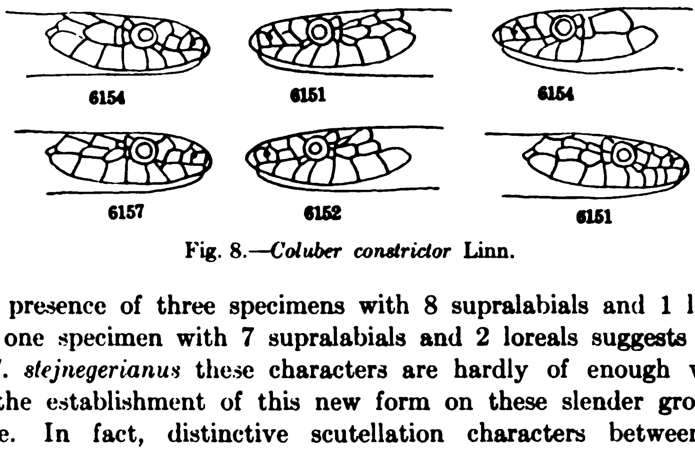


Fig. 8.—*Coluber constrictor* Linn.

The presence of three specimens with 8 supralabials and 1 loreal and one specimen with 7 supralabials and 2 loreals suggests that in *C. stejnegerianus* these characters are hardly of enough value for the establishment of this new form on these slender grounds alone. In fact, distinctive scutellation characters between *C. constrictor* and *C. flagellum* become scarce in the light of this large percentage of 8 supralabials in our collection. The characters of the frontal and color become more than ever the main reliance.

Habits.—This species and the spreading adder are the two most common snakes of the drier parts of the swamp. It seems to prefer the cover of the blueberries and saw palmettoes, where it swiftly pursues its prey. It, however, also appeared commonly about the Lee's clearing, where it was often seen but seldom captured. Only when we could get it in the open did we stand a fair chance of taking it alive, so lightning-like are its movements. In fact, it is fast enough to catch anything which moves on the ground of its environ-

ment, and no doubt its omnivorous appetite is partly due to its speed. It can climb among the bushes, though we usually found it on the ground. The natives think it beneficial and allow it to climb into their corn cribs because it catches the troublesome rats and mice.

Food.—It is considered harmless, and of its antipathy for rattlesnakes we neither saw nor heard any evidence. It doubtless will attack the poisonous snakes, but not to the extent that its arch-enemy, the king snake, does. Its speed is marvellous, and all the lizards of the swamp prove its prey. This even includes the "race nag" (*Cnemidophorus sexlineatus*), which suffers most; at least two of our specimens had the tails of these lizards in their stomachs, indicating that the lizards were swallowed head first. One cannot help wondering how the blacksnake captures these speedy reptiles. Another species which the blacksnake uses for food is the slowest lizard of the islands, the ground lizard (*Lygosoma laterale*). In some of the specimens we found sand in their stomachs. This species is very fond of frogs and toads, all the dry-land forms being in the list, the toad (*Bufo l. lentiginosus*) occupying first place. One snake had 4 adult Carolina tree frogs (*Hyla carolinensis*) and 1 pine-wood's tree frog (*Hyla femoralis*) in its stomach; all being taken head first. It seems not to scorn insects, beetles being the principal group identified.

Parasites.—This species is quite badly troubled with internal parasites, five of the thirteen specimens having such in their alimentary tracts. The first snake captured—a young one—had mites all along the edges of the gastrostegal plates, a condition subsequently observed in one or two other specimens.

[redacted]

32 mm. ($1\frac{1}{4}$ inches) x 18 mm. ($\frac{11}{16}$ inch).
39 mm. ($1\frac{9}{16}$ ") x 16 mm. ($\frac{5}{8}$ ").
36 mm. ($1\frac{7}{16}$ ") x 17 mm. ($\frac{11}{16}$ ").
30 mm. ($1\frac{3}{16}$ ") x 18 mm. ($\frac{11}{16}$ ").

Three others quite fresh in appearance when ploughed up were:

36 mm. ($1\frac{7}{16}$ inches) x 17 mm. ($\frac{11}{16}$ inch).
36 mm. ($1\frac{7}{16}$ ") x 18 mm. ($\frac{11}{16}$ ").
41 mm. ($1\frac{5}{8}$ ") x 16 mm. ($\frac{5}{8}$ ").

Another batch of four taken in a similar way had been developing for a time and at preservation measured:

36 mm. ($1\frac{7}{16}$ inches) x 22 mm. ($\frac{7}{8}$ inch).
33 mm. ($1\frac{3}{16}$ ") x 23 mm. ($\frac{7}{8}$ ").
34 mm. ($1\frac{3}{8}$ ") x 22 mm. ($\frac{7}{8}$ ").
36 mm. ($1\frac{7}{16}$ ") x 22 mm. ($\frac{7}{8}$ ").

In all these eleven eggs the usual shape is elliptical with blunt, rounded ends. In the first and second sets, one egg is much more elongate and one end more pointed than the other. This tendency toward the ovoid form also comes in the third set, where development has progressed and the increase in size has been in girth. All these eggs when laid are white with tough, coracious shells which are covered with small crystal-shaped or cup-like granules. These make the egg quite distinctive.

6. Elaphe guttatus (Linn.): Corn Snake; Rat Snake; Chicken Snake; Red Chicken Snake; Mouse Snake; House King Snake; House Snake; Spotted Snake; Spotted Racer; Spotted Coluber; Red Coluber.

Only two specimens (Nos. 6,229, 6,230) were taken July 15–November 1, 1912, after our departure. Beyer[31] thinks of them as fairly common in pine-wood regions, but says, "It is not found in the swamp lands, being strictly terrestrial in its habits." Certainly, this form must have travelled through swamp to reach Billy's Island and doubtless encounters moisture enough on the islands.

Coloration.—This beautiful snake is light red or ashy-gray, with a series of dorsal dark red, crimson or brick-red saddles or transverse bars. These are 3–5 scales wide, occupy from 10–13 rows and have dark-edged borders. On one specimen there are 50 in all, 36 before the vent and 14 beyond it; in the other, there are 41 blotches, 29 before the vent and 12 beyond it. On either side appears an alternating row of smaller dark-bordered red spots. Anteriorly, these

[31] Beyer, Geo. E. La. Herpetology, *Proc. La. Soc. Naturalists*, 1897–1899, New Orleans, 1900, p. 39.

become very narrow and the elongate black borders constitute most of the spots. The third row on the first four rows of scales only shows distinctly in the anterior region. The venter has a tinge of the color of the back, but appears to be mainly white or yellowish-white, tessellated or checkered with quadrangular black spots. In markings of the head these specimens very well agree with *Elaphe guttatus guttatus.*

Dimensions and Variations.—These two specimens are, respectively, 97.3 and 111.8 cm. long; the tails, 16.2 and 18.7 cm., or 6 in the total length; the gastrosteges are 218, 227; the urosteges, 69 and 68; anal divided; the scales are 24–27–18 and 23–27–19; the oculars 1–2; the temporals 2–3 (4) and 2–3; the supralabials 8; the infralabials 11 and 12.

Food.—This species belongs to the group known as rat snakes, and each specimen proves true to racial reputation. In the stomach of each we found a full-grown rice-field rat (*Oryzomys palustris*) and other remains. Both of the rats had been swallowed head first, and we firmly believe them to have been taken alive. This requires considerable dexterity in nature where the prey is not cornered and may also be another bit of evidence to show this species more aquatic than usually thought. No parasites were found in the alimentary tract of either specimens.

7. **Elaphe obsoletus** (Say): Pilot Snake; Chicken Snake; Spotted Chicken Snake; Gray Coluber; Gray Rat Snake. Fig. 9.

Six specimens of this puzzling form were taken, and we regret this series is not larger. However, this small collection confirms us in the belief that *Scotophis confinis* B. and G., *Coluber obsoletus lemniscatus* Cope, *Coluber spiloides* Dum and Bib., possibly *Scotophis*

at the angles by a longitudinal stripe on each side, as in *Coluber obsoletus lemniscatus* Cope. The dorsal spots are 3–4 scales long and cover 8–10 rows of scales. On the 2d–6th rows occurs a lateral row of spots which alternate with the dorsal spots. In the anterior region they become very elongate and linear. In No. 6,136, with two faint dorsal longitudinal bands, this lateral row is connected by a longitudinal band on each side, the band obscuring the spots in the caudal half of the body. Thus, in this specimen, we have the four bands of *C. quadrivittatus*, but the spots of *C. spiloides* or *C. o. confinis*, in other words, a good *C. o. lemniscatus* Cope. To add to the confusion, the temporals on one side are 2–3–5 while on the other side they are 2–1–2. Beneath the lateral row of spots occurs another row just above the gastrostegal keel of each side. Each of these spots is opposite a dorsal spot and occupies the first row of scales and the ends of 2 sometimes 3 gastrosteges down to the gastrostegal keel. Sometimes, however, this lowest row of spots does not alternate with the lateral row and sometimes this lowest row is obscure. The venter in the large specimens is yellowish-white or straw-color (most yellowish in the *quadrivittatus-lemniscatus* specimen), while the two smallest specimens have it whitish or ashy-white. In some, irrespective of size, the venter in the cephalic fourth or fifth of the body is immaculate, while in others it is with spots like the ground color of the dorsum; the venter posteriorly may be almost solid in color like the dorsum. In some, the chin and throat area may be immaculate yellow, yellowish-white or white or the gulars may be slightly grayish. In all the infralabials have black borders as have the supralabials, but the intensity of this color varies. Two specimens have no postocular band at all, one of the smaller ones has it indistinct, another has it on one side and absent on the other and two have it very prominent. Only two have the darker black prefrontal cross band (on posterior margins). The presence or absence of head bands in this assemblage of snakes is too variable and individualistic a character to be of much weight in separating species. Some of our specimens have the head uniform like the body color; others are with distinct head bands.

Dimensions and Variations.—The six specimens vary in length from 68.7–144 cm., the tail from 12.8–27 cm. or 5.0–6.2 times in the total length. The gastrosteges range from 231–243, or average 236; the urosteges are 71–92 or average 85; anal divided, in No. 6,135 entire; the oculars are 1–2, except in No. 6,135 where 1–2 and 2–2, the upper preocular coming from the forward part of a normal

supraocular; supralabials 8, except in one specimen where 8 on the left side and 9 on the right side; eye resting on the 4th and 5th supralabials; infralabials 11 or 12; temporals variable, in three specimens 2–3 as in *C. spiloides* Dum. and Bib., in one 2–3 on one side and 2–1 on the other, in another 2–3 and 2–4, in a sixth 2–3 and 3–4, the last a duplicate of Cope's figure 196, p. 851, for *C. lactus* B. and G., and, strangely enough, the 2–3 condition barely escapes being 1–2; in fact, in just these six specimens on one side or on the other we practically have duplicates of the temporal scutellations of Cope's figures 191–196, namely, for *C. rosaceus*, *quadrivittatus*, *spiloides*, *obsoletus obsoletus*, *obsoletus lemniscatus*, and *lætus*—rather too strong an individualistic a variation in a localized collection of six to make it a stable and cardinal character of primary dictinction.

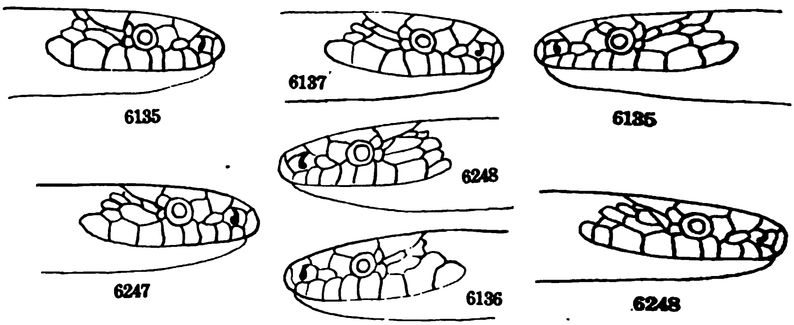


Fig. 9.—*Elaphe obsoletus* (Say).

The scale formulas are 29–29–19 for two specimens, 29–27–19, 27–27–19, 26–29–19, 25–27–17; from 9–23 keeled rows of scales;

found along the water courses near Billy's Lake. Here they climb up the bushes and small trees which skirt some of the streams of the swamp. Our first specimen was 6 feet up above the water, and they have ascended 10 or more feet in our few experiences with them. They are probably far more common than our collection might imply, but their position, the cover of the dense herbage and the color of the body, all make them rather difficult to find.

Breeding.—This is an ovoviviparous snake and three specimens taken June 1, 3 and 15, 1912, had the eggs quite immature. One had 18 on the left side and 15 on the right side; another had 14 in all, 8 on the right side and 6 on the left side.

Food.—No doubt this form secures much of its food in the bushes and trees it so commonly frequents, and true to the reputation of *E. obsoletus* of the north this Okefinokee representative proves an enemy of the birds. The natives steadfastly held that it ate birds' eggs and young. One specimen had partaken of some kind of eggs and a second individual had birds' feathers in its stomach. A third snake had eaten the pine-wood's tree frog (*Hyla femoralis*). This species also frequents the islands and feeds on the ground. Here they do damage to the ground-nesting birds, as many of the other species of snakes do. They also often enter poultry yards for rats and mice as well as the hens' eggs. One of the native boys brought us a pilot snake which he claimed was caught in the act of swallowing a hen's egg, and stomach contents substantiated his claim. They report that they have taken some which had eaten as many as ten at one time. None of these six snakes had parasites.

8. Lampropeltis doliatus coccineus (Schlegel): Scarlet King Snake; Red King Snake; "Coral Snake." Fig. 7.

Six specimens of this fine, beautiful snake were taken on Billy's Island. The nearest records are from Fernandina, Fla. (C. F. Batchelder), and from Gainesville, Fla. (J. Bell). Each of these Cope accredits to the form *Osceola elapsoidea* Holbrook.

Coloration.—Ground color scarlet (fainter below) covered with 14–20 pairs of black rings on the body from head to anus and with 3–6 pairs on the tail. These rings inclose white or yellowish intervals, which are 1–1½ scales wide on the dorsum and 2½–3 scales wide on the side, the black rings themselves each being 2–4 scales wide. In only one specimen, No. 6,240, do the rings completely and perfectly encircle the body for its entire length, and, in the caudal region, the abdominal white interval has a black spot between the black rings. In the other specimens the rings just fall short of meeting each other

on the venter and sometimes their ends alternate. Frequently, the black bands of a pair have their ends uniting with each other and not with opposite ends. Occasionally the process goes farther and on the sides a black bar extends from one black band to another across the white interval and we have part of a white interval completely encircled by black dorsally and ventrally as well as on the sides. The black band on the neck is not complete on the ventral side in any of the six individuals; ahead of it, comes a white or yellowish-white interval, narrower on the dorsum but wider on the sides where it extends across the angle of the mouth onto the upper posterior labials and on the lower surface of the head. The black occipital bar in one specimen is limited to one occipital; in the others it generally reaches to the temporals and the posterior edge of the frontal and the supraoculars. In one specimen there is a black band back of the eye, and in another the occipital black bar covers the occipitals, most of the frontal, all of the supraoculars, postoculars and 1st temporal and the upper surface of the two posterior supralabials. Sometimes the supralabials near the eye and rarely a few infralabials immediately below may have dark margins.

Dimensions and Variations.—The total length varies from 23.7–57.6 cm.; the tail, 3.4–8.9 cm. or 6–7.2 times in the total length; the gastrosteges are 172–189; the urosteges 39–48; anal entire; the supralabials 7; infralabials 8 except on one side of No. 6,240, where there are 9; the oculars are 1–2.

From a study of these six specimens from one locality we were led to conclude that *Lampropeltis doliatus coccineus* and *Osceola*

the whole, it may accord best with a sound method to take no note of this form at its present stage." C. S. Brimley says that in his experience "the normal formula is, scales in 19 rows, occasionally 17 or 21, one temporal in first row, occasionally two, and loreal usually present, but sometimes absent on one or both sides."[23] Only in his Florida specimens were the scales in 17 rows. Like these, our specimens have a greater reduction in number of scale rows than Cope's material, the formulæ being 17–15–15, 17–19–15, 17–19–15, 17–19–17, 17–19–17, 17–19–17. This is a reduction far beyond the 21 rows of Cope's and Brown's descriptions and if anything below the better normal of Brimley. So, in this respect, our specimens incline towards *Osceola elapsoidea*. Furthermore, only in the specimen (No. 6,100) with this reduction carried farthest (17–15–15) do we have the loreals of both sides absent, but it is one of the largest of the six specimens. In this individual the prefrontal has descended to the level of the labial and in the forms (*L. d. coccineus*) with loreals these plates must be derived from the prefrontal. In No. 6,242 the loreal is very small and linear, while in No. 6,240 it is normal and quadrangular on one side and triangular on the other, the apex not even touching the preocular. In 3 specimens (Nos. 6,101 the smallest, 6,241, 6,249 the largest) the loreal is present on both sides and a prominent quadrangular plate from the preocular to the nasal.

Habits.—This species is more or less of a burrower, but a glance at some of the largest specimens suggests *Elaphe* snakes in their compressed deep bodies with sides sharply defined from the venter by a ridge. Such elaphine snakes climb well and of such evidence in *L. d. coccineus* we have only the capture of a snake taken June 6, 1912. It was found on one of the frames of an old building, the snake being 3½–4 feet above the ground.

Food.—In food habits this species is more or less of a constrictor. It feeds on ground lizards, skinks, swifts and other snakes and insects. In the stomach of No. 6,242 we found an angleworm and the remains of two killifishes, suggesting more of any aquatic nature than usually ascribed, but after every rain Billy's Island is covered with little water pools containing fish which as evaporation goes on become stranded. Such would be easy of capture. Our specimens yielded no clue to the oviparity or breeding of this species.

[23] Brimley, C. S. Notes on the Scutellation of the Red King Snake, *Ophibolus dcliatus coccineus* Schlegel, *Jour. Elisha Mitchell Soc.*, XXI, No. 4, December, 1905, pp. 145–148.

9. Lampropeltis getulus getulus (Linn.): King Snake; Common King Snake; Chain Snake; Thunder Snake; Thunder and Lightning Snake; Wamper; Wampum Snake; Rattlesnake Pilot. Plate III, fig. 2; fig. 10.

Thirteen specimens of this fine snake were taken and many more seen. It is common throughout the drier parts of the swamp and frequents the outskirts of the swamp as well. It keeps to the islands and none were taken in other situations than the saw palmetto or heath societies of the piney woods where it courses through the low cover after its living prey or eggs. Okefinokee swamp comes within the supposed range of *L. g. getulus* and is considerably east of Louisiana where *L. g. sayi* is recorded. The nearest records of *L. g. getulus* are from Fernandina, Fla. (C. F. Batchelder), Gainesville, Fla. (J. Bell), and Nashville, Ga. (W. J. Taylor).

Coloration.—Most of the specimens at hand vary from a light to a deep brown. Five are shining blackish-brown in body color, but these are among the smallest specimens of the collection. All thirteen have white or yellowish cross-bands which may be from 23–25 in number on the body proper, rarely as low as 18, and from 5–10 on the tail. Often these bands are incomplete and appear only on one side with none corresponding on the other side, and frequently in such specimens the cross-bands may be diagonal—not strict cross-bands; in many of the specimens the bifurcations on the sides are absent and the cross-band scales of the dorsum have dark body color tips which at times so blacken the scales as to interrupt the bands completely. In one specimen the band was very indistinct. These bands are normally 1½–2 scales wide on the dorsum or rarely 2, rarely 3–5 scales wide on the sides where the bands bifurcate bordering a spot of body color. These lateral spots alternate with similar

spots, particularly so in No. 6,218. The three subspecies *getulus*, *sayi* and *splendidus* intergrade so imperceptibly and specimens from one region sometimes reveal all the supposed distinguishing characters.

Dimensions and Variations.—These specimens vary from 67.6–144.4 cm. (2 ft. 1 in.–4 ft. 9 in.) and the tail from 9.1–19.3 cm. (7.4–9 in the total length); the gastrosteges are 214–223 or average 218; urosteges are 41–54 or average 49; the scales are 21–21–19 in eight of the specimens and the other formulas are 21–23–19, 22–21–19, 23–21–19 twice, 23–23–19; the oculars are 1–2; supralabials 7; infralabials 9 or 10; temporals may deviate from 2–3, the formula for ten specimens, one specimen has them 1–3, another has 2–2 and a third 2–3 on one side and 2–4 on the other; the loreal is present in all and in No. 6,218 (*sayi*-like specimen) there are two on the left side. The anal is entire, in No. 6,139 it is entire, but the gastrostege ahead is divided and in No. 6,140 the anal plate is divided into three parts.

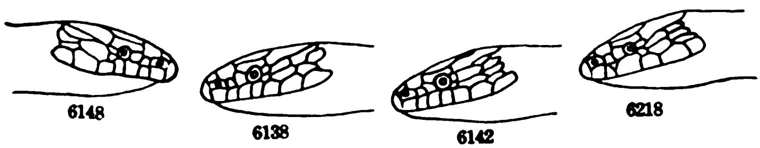


Fig. 10.—*Lampropeltis getulus getulus* (Linn.)

Habits.—This species is one of the most strikingly marked snakes of the swamp. The shining black or brown with the contrasting white or yellow cross-bands makes its appearance very attractive. In nature, it is mild, proves an interesting and safe pet, and in no instance during our stay in the swamp did it display any tendency toward belligerency or sullenness toward any member of the party.

Food.—The natives recognize its good nature and consider it harmless, though the king of the snakes. They are aware of its usefulness as an enemy of moccasins and rattlesnakes and report several combats which always resulted successfully for the king snake, but these unlettered people, unlike many sentimental writers, do not hold that the king snake deliberately searches for the poisonous snakes in particular. We, as they, believe it the enemy of every species of snake in the swamp, preying of course more on the terrestrial species of its own haunts. All the smaller snakes suffer, and of the larger species, the blacksnake and spreading adder are the commonest prey. It is surely a good "pilot" to the naturalist

whenever one finds it digging, for it almost invariably means other snakes, eggs or some good capture. It will seldom fail to react per schedule if you loosely hold it in one hand and a live blacksnake in the other. Almost before you can predict the outcome, the former may be far within its captor—a demonstration we have tried more than once in the field. It is especially fond of young snakes. One of our specimens had taken a newly hatched *Heterodon* and the natives recounted several occasions when they had found it working beneath a log for what proved a brood of young snakes. We do not doubt but that it feeds on mice, rats and other small mammals, but of such evidence we found little in the swamp. Possibly, in early spring or in the fall these are more its reliance. The principal food of this species is turtles' eggs, with snakes or their eggs a second choice. Four of our specimens had eaten Florida cooters' (*Chrysemys floridana*) eggs which they dug out of the sand and two had mud turtle (*Cinosternum pennsylvanicum*) eggs in their stomachs. Mr. Francis Harper tells us that he and David Lee almost stepped on a king snake. After their recovery, what should they find but a *Kinosternon* digging in sand probably preparatory to laying and the king snake was close at hand. In fact, so addicted are they to this egg diet, that the natives consider that it is a common happening to find the snake awaiting the egg deposition. Unless it be the Florida bear, there is no form in the swamp which eats turtles' eggs in such quantity as the king snake. It will take a whole nest of eggs at one time, as many as 14 being found in the stomach of one snake.

Breeding.—Of the breeding habits of this species we have a few scant notes. Mr. Harper reports a pair of them mating on May 10

anteriorly; the back and sides with 20 pairs of black half-rings, the first on the head, the 16th just back of the anus and the last two rather indistinct. The black half-rings are widest dorsally, on the sides the black rings of a pair approach each other soon to diverge again as the 4th–2d rows of scales are reached. An irregular black spot on the 1st row of scales at the lower end of each white interval sometimes unites the ends of two half-rings; bands between half-rings ivory-white with very fine dots all over the scales. Width of each black half-ring usually two scales, but one scale wide half way down the sides; the interval usually three scales wide. The first black band narrow and extending from 1st temporal along the anterior margins of the occipital plates to the 1st temporal of the other side. First temporal may be entirely or half black. The gastrosteges almost entirely free of markings.

Dimensions.—The total length is 36.4 cm.; the tail 5.4 cm. or $6\frac{3}{4}$ in total length; the gastrosteges 169; urosteges 19; anal entire, but a half gastrostege ahead of it; temporals 1–2; the nasal divided below nostril; supralabials 6, eye resting on the 2d and 3d supralabials; infralabials 7; loreal point almost enters eye's orbit on the left side, but is more remote on the right side.

Breeding.—This specimen, taken June 20, had three white eggs which were very elongate and with thin membranous integument. They were, respectively, 34, 35, 35 mm. long.

11. **Tropidonotus taxispilotus** (Holbrook): "Water Moccasin"; Pied Water Snake; Brown Water Snake; Water Rattle; Water Pilot; Aspic.

Only eleven specimens of this species were taken, yet it is common along Billy's and Minne's Lakes, Log River and all the more open water courses. It was not far from the Okefinokee Swamp that Holbrook secured one of his two specimens for his original description, namely, from Altamaha River. The natives were not anxious to help us in the captures of this species.

Coloration.—The coloration is a light chocolate- or reddish-brown, sometimes rusty with a series of three rows of large subquadrate or rectangular spots, the dorsal row varying from 23–27 dark brown or black spots before the anus and 15–18 behind the anus, the averages being 25 and 16, respectively. Anteriorly, the spots are 3–4 scales wide and posteriorly 2–3 scales wide. In transverse width the larger spots cover 8–10 rows of scales. Alternating with the dorsal spots is a row on either side. These spots cover from the 1st to the 10th row of scales. Normally, the lateral and dorsal spots do not touch as the descriptions assert, but in almost every specimen one or two

sets, particularly in the middle of the body, are connected by a black line 1 scale wide. The venter is white or yellowish. Holbrook's description, "Most of them (gastrosteges) with a black spot at either extremity and the centre dotted minutely with black," applies to some of the younger specimens very well, and in almost all the older individuals the same coloration can be discovered, namely, two rows of squarish black blotches with a dusted lighter line down the middle of the belly. Rarely, the black obscures all semblance of pattern. The gular gastrosteges usually are without the lateral spots and the whole anterior edge is black bordered; the head is like the body in color; the lower labials have a fine dusted appearance.

Dimensions and Variations.—The specimens vary in length from 63–130.5 cm., all except four being over 100 cm.; in the largest specimen (130.5 cm.) the tail is 30.5 cm. long and the tail is contained in the length in the eleven specimens from $3\frac{4}{5}$–$5\frac{1}{4}$ times, 4 or $4\frac{1}{2}$ being the normal. The gastrosteges are 130–142 or average 135; the urosteges are 62–70, the average 67, far below the 70–90 of Cope and Brown. Anal plate usually divided; in three specimens with a half gastrostege ahead of it and in one or two a whole gastrostege divided, otherwise this plate anterior to anal plate is entire; in No. 6,111 the anal is entire and in No. 6,224 it is also entire with a faint transverse median furrow extending halfway backward toward the anus. The scale rows are far below 31–33 rows, the combinations being 27–27–21, 28–28–22, 29–31–22, 29–29–21 twice, 29–30–23, 29–30–22, 30–30–25, 30–29–22, 30–28–23, 31–31–21 or in the middle of the body from 27–31—not 29–31 or 31–33 as dis-

shoot into the water sometimes the pied belly reveals that it is *T. taxispilotus*, and not *T. fasciatus* or any of its subspecies.

The pied water snakes are very large and in general very shy and elusive. We had been in the swamp for 2½ weeks before we captured our first specimens, although some of us passed them daily. At first we had to shoot them as they rested in the open on branches 2–3½ feet above the water. Then their capture was not always certain, for we often lost them because of our caution in landing them. The natives are afraid of them, and whoever has wounded or had experiences with this species in its wild state knows they are vicious and belligerent when hard pressed. The natives call them "water moccasin" and consider them as poisonous as rattlesnakes or true moccasins. Once when one of us was bitten by a medium-sized specimen the Lees awaited the result with considerable solicitude for the supposed unfortunate. After two weeks of attempts, we were growing impatient because we had taken none of the largest individuals, and "Alligator Joe," one of the visitors, when fishing, stunned a "water moccasin" and considerately put it in the prow of his boat. We had almost reached him when the snake revived, and in the twinkling of an eye he had thrown his present into the lake with his oar. Man and live "water moccasin" in the same boat was not conceivable. And there is plenty of reason for *our* common respect for this large water snake, which reaches 5 or barely 6 feet. The largest specimen secured measured 4½ feet. Several specimens in hand measure in girth from 7–8 inches, and we are positive we have seen individuals with a circumference of 10–12 inches. Especially is this true of the females as the embryos develop. Then the skin is so distended that $\frac{1}{16}$ to ⅛ of an inch or more separates each of the scales.

Breeding.—This species is ovoviviparous. The specimens taken in the middle of June showed the developmental stages little advanced. One specimen (No. 6,113), 2 feet 10 inches long, had only 14 embryos, while another, 4½ feet long and about 8 inches in circumference, had 40 embryos. It is rather a significant fact that all the larger individuals taken are females. Either the large males were too fast for us or the females are larger or occupy more exposed positions and may prove more sluggish or braver. The individuals taken from July 15–November 1, 1912, showed the embryos much farther advanced and some had unborn embryos 26 or more cm. long. One specimen (No. 6,256) had 58 embryos, 32 on the left side and 26 on the right side. The normal number seems to be 35–40 embryos.

Food.—This animal will eat almost any animal which it finds in the water or above it, provided it can swallow or capture it. One specimen (No. 6,116) had two frogs (*Rana sp.*) in its stomach; another (No. 6,260) had a small warmouth (*Chænobryttus gulosus*) and a third had other fish remains which were not to be identified. Five of the individuals had internal parasites in the stomach, or about $\frac{1}{7}$ of all the snakes so troubled were of this species.

12. Tropidonotus fasciatus (Linnæus): "Moccasin"; "Water Moccasin"; Southern Water Snake; Banded Water Snake. Fig. 11.

Ten snakes not of *T. taxispilotus* were taken in the swamp. These are so variable in coloration and also in scutellation that we hesitate to add to the confusion which obtains in the interpretation of the *fasciatus* group. Many varieties, subspecies, geographical races, forms or phases have entered the literature of North American Natrices, and these are based mainly on temporal and ocular scutellation, number of scale rows and coloration. These cannot all be assigned faunistic or geographical areas and most of them are as yet likely to appear in one region if a large series be taken. The group is very variable and some of the forms designated may be variants struggling to assume a stable varietal form or geographical place. As yet, however, this gamut of variation apparently appears independent of geographical environments and is almost possible if not actually existent in one region. Therefore, the safer and more conservative course is to place them together and not take any *Cratægus* course until more certain of our ground. Intensive localized study and possible breeding as well as extensive geographical collecting with few personal equations seem the hopeful solution of the question.

Coloration.—The smallest specimen (No. 6,227) in coloration is

and the under surface of the tail consequently looks darker than the anterior ventral region. These black borders unite on either end of the gastrostege and thus enclose a transverse elliptical central area of yellow. Also along each end of the gastrostege opposite the lateral spot of the side the gastrostegal black border encloses another small area of yellow. Thus, we have a central row of transverse yellow gastrostegal spots and a row on either end of smaller encircled yellow spots, very much like the venter of *T. compressicaudus* Kennicott (see description Brown, p. 34). This species is Floridan and might enter the Okefinokee. Furthermore, *T. compressicaudus walkeri* has 23 rows of scales as has our specimen. Finally, our specimen (*rhombifer*-like on dorsum except for the neck) has on the neck four black longitudinal bands, the two of either side being connected posteriorly. The labials are yellowish with dark borders. There are no bands on the head. Many of our specimens—in fact, practically all—have the tail quite strongly compressed at its base and heavily carinated, and an examination of supposed *T. f. erythrogaster*, *T. f. transversa*, *T. cyclopium* and *T. rhombifera* material from other localities does not impress us that this relative character is sufficient to set *T. compressicaudus* apart as a separate form from *T. fasciatus*. Eight of the ten specimens have no more than 23 scales, and always this number in the middle of the body; three having 23–23–19, two 23–23–17, one 23–23–18, one 23–23–20, and one 21–23–19. Some of these may well be *T. f. pictiventris*, and were so identified in the field with only Cope's work at hand. This form he restricts to Florida, and he has specimens from Gainesville and Palatka, not far from the Okefinokee. He considers it close to *T. compressicaudus* in coloration of the belly. But some of our specimens clearly have the *compressicaudus-pictiventris* coloration to which there is added the reddish abdominal spots of *T. fasciatus fasciatus*. One specimen (No. 6,228) has no lateral or dorsal spots apparent, the belly an immaculate salmon-pink, except under the tail where a bluish-gray enters, and the scales strongly carinated—all characters of *T. fasciatus erythrogaster*. Some specimens show the lateral space with reddish or reddish-brown of *T. fasciatus fasciatus*. Some of the ten showed the yellowish labials with strong black borders and most of these individuals have the two light dots close to the suture of the occipitals. One specimen (No. 6,119) is a uniform grayish or greenish-brown on the back including the head which has no postocular band, and the belly is whitish or yellowish-white with hardly any suggestion of gastrostegal borders (faded-out brown). Another very large speci-

men with a few reddish bars evident on the sides has a yellow venter with black gastrostegal borders not strong, but on the end of each gastrostege the blue-black of the back encroaches for ½–¾ of an inch and makes a striking lateral border for the yellow of the middle of the venter. Finally, we have another specimen (No. 6,231) with scales 21–25–21 and dorsum grayish-black above. The only marks evident are transverse white dorsal bands ½ scale wide which become less distinct as the belly is reached. The entire underparts are grayish-white with gastrostegal borders grayish-black. These borders surrounding the urosteges make two rows of encircled spots on the under surface of the tail. It is, we believe, a *T. fasciatus*, yet far from the ordinary coloration.

Dimensions and Variations.—These specimens vary in length from 28–118.7 cm., the tail from 7.9–29 cm., or 3.5–4.5, average 3.7 in the whole length; gastrosteges are from 123–133, the urosteges

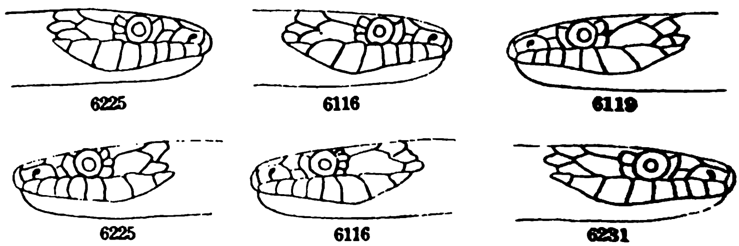


Fig. 11.—*Tropidonotus fasciatus* (Linn.).

from 67–85; supralabials 8; infralabials 10, rarely 11, sometimes 10-11 as in two specimens or 11–12 as in one; the temporals are 1–3 in seven specimens, in one of which on both sides the first temporal has captured the normal third temporal of the second row

until the group is very carefully collected, bred and studied from a large series from several of their supposed geographical habitats.

Habits.—This species was not so common as the pied water snake. Like it, however, this snake is called "water moccasin" by the natives who fear it. One evening, one of us accidentally punctured his thumb on the teeth of a recently killed snake of this species. The next morning several of the native family very concernedly wished to see how bad the thumb would be. Unlike the pied water snake, it is fairly common on the water prairies and about the edges of the islets ("houses" or "heads") of the prairies. We also took this species in the water ditches on the outskirts of the swamp and along the lumber railroad ditches. We were unable to find a single snake of this species along the larger water courses where the pied water snake apparently replaces it. It seems to be more a form of the moist situations on the islands and possibly in the wooded, swampy parts. In disposition it is like other water snakes, but is a poor second to its relative, *T. taxispilotus*, in pugnacity.

Food.—It feeds largely on aquatic animals. One specimen (No. 6,116), taken May 30, 1912, had two frogs of the most aquatic species of the swamp (*Rana sp.*) in its stomach and two (Nos. 6,231 and 6,115) had taken a southern meadow frog (*Rana pipiens sphenocephala*). Only one of the ten had parasites in its stomach.

13. Storeria dekayi (Holbrook): DeKay's Snake; DeKay's Brown Snake; Little Brown Snake; Brown Snake; Ground Snake; Spotted Snake; Spotted Adder; Brown Grass Snake. Fig. 12.

Two specimens (Nos. 6,237, 6,239) were secured between July 15 and November 1, 1912, by Mr. Jackson Lee, of Billy's Island. This form and its congener, the red-bellied snake, are commonly associated with dry grounds, but certainly at some seasons within the swamp it must find it impossible to find such a habitat, and it may be less averse to wet situations than once thought.

Coloration.—Both specimens have the usual grayish-brown or ash-gray on the upper surface with the pale vertebral line bordered by black dots. The venter is white or yellowish-white in alcohol and the row of dots near either end of the gastrostege is present. Besides these, there are finer dots widely separated over the whole belly. The neck has a black band extending from the ends of gastrosteges Nos. 3–5 across the angle of the mouth to the mid-dorsal line where it meets its fellow of the other side. In front of this bar a white band of belly color reaches across the sixth and seventh infralabials and on the sixth and seventh supralabials. The 3d–5th supralabials and the same infralabials are almost entirely black.

Several of the other labials are with large black spots or margins. The dorsal head plates of body color are with a strong sprinkling of black. One specimen (No. 6,239) superficially looks almost as black as the specimen of the red-bellied species did.

Dimensions and Variations.—The gastrosteges were 135 and 138, respectively; the urosteges 62 and 48. The total lengths were 24.4 cm. and 29.3 cm.; the tails 5.8 and 5.2 cm. or 4½ and 5⅝ in the total length. There are 7 supralabials with the eye resting on the 3d and 4th; the infralabials 7; no loreal; temporals 1–2; anal plate divided, in one specimen with a half gastrostege in front of it. The oculars of No. 6,237 are 1–2 on both sides, but on the right side the preocular is almost divided into two, while No. 6,239 the oculars are 2–2. This character coupled with the scales 15–15–15 in both specimens raises the query whether 15 or 17 rows of scales and 2 or 1

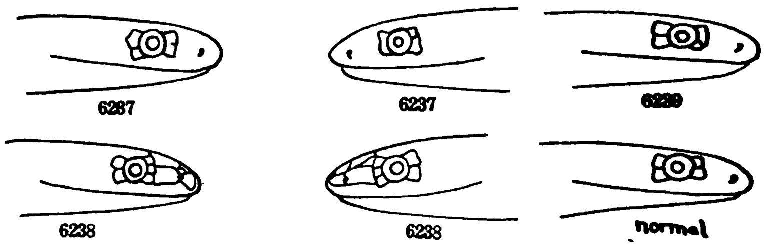


Fig. 12.—Upper figures, *Storeria dekayi* (Holb.). Lower figures, *S. occipitomaculata* (Storer).

preoculars are constant differences between *S. occipitomaculata* and *S. dekayi* as commonly held. Besides, the red-bellied specimen shows greater variation in preoculars by being 3 instead of 2.

Habits.—This species is nocturnal, spending the day beneath logs

the range of the species. This small, largely nocturnal inhabitant beneath stones, logs and other cover usually averages smaller than *S. dekayi*, and our specimen proves smaller than the two specimens of the latter species taken in the swamp. The tail is lost, the specimen measuring 17.9 cm. to the vent. The gastrosteges are 120; scales 15–15–15; temporals 1–2; supralabials 6; infralabials 7. Unlike most of the descriptions, the ocular formulæ are 3–2 for both sides, instead of the 2 preocular condition usually noted. On the right side of the head appears a small supranasal above the nostril and at the common corner of the internasal, prefrontal and two nasals. On the left side is a similar plate not touching the internasal. Other specimens from other Georgian localities (Dr. J. C. Bradley, collector) reveal no such condition, and the present specimen may have had some accident, although it is not especially apparent.

The head in front of the three occipital color spots is much darker than the rest of the body; in alcohol it looks black—in fact, darker than any other specimen of the species we have ever recorded. The characteristic light spot of the fifth supralabial is, however, not wholly obscured. This specimen, like Hay's record, had a slug in its stomach and insect remains in its rectum.

15. Haldea striatula (Linn.): **Brown Snake; Worm Snake; Ground Snake; Little Striped Snake. Plate III, fig. 4.**

One specimen was secured on Billy's Island. In the Central States this small snake extends from Minnesota to Texas, while in the Eastern States its range from Virginia southward has not its southern limit well determined. We can find no definite locus beyond W. J. Taylor's (Cope, 1900, p. 1010) record for Nashville, Ga., which is 50 miles northwest of the Okefinokee Swamp. Ditmars[34] gives it as extending to Florida, where it might well be, but in this State Loennberg (1895, pp. 317–339) did not secure it.

Coloration.—The field description of the color of this specimen is as follows: Color of the back with the skin bluish and scales brownish or opalescent; each scale with fine speckings, which sometimes assume a black edge on the cephalic end of the scale. The color of the dorsal scales extends onto the ends of the gastrosteges, fine speckings accompanying it. The gastrosteges are greenish-yellow or opalescent. A pinkish-like area occurs on the side of the head. It crosses the last lower labial, the 4th and 5th upper labials and first temporal and cephalic ends of the second row of temporals. It then fades as it crosses the middle of the occipital plates. The

[34] 1907. The Reptile Book, p. 271.

venter of this adult did not impress us as salmon-colored. The total length is 223 mm. and the tail 34 mm., or 6½ times in the total length. In other specimens from other regions the short tail ranges from 5½–7¼ in the total length. The longest specimen of this species we have seen reached 283 mm. There is no particular deviation from the normal in the scutellation of this specimen. The eye rests on the 4th supralabial and on the posterior end of the third supralabial. The ventral plates are 134, the subcaudals 37.

Habits.—This specimen was found a rod from the thick, swampy cypress edge of Billy's Island. Associated with it was one of the few salamanders found on the trip. The ground was decidedly moist, yet the vegetation was of the pine-barren type. Inasmuch as it was under the cover of a more or less disintegrated log when taken (mid-forenoon), we conclude that it is distinctly a nocturnal form. This specimen had no food within its alimentary tract, but its habitat and previous assertions regarding its food suggest that it feeds on worms, larvæ of insects, etc.

Breeding.—It is well established that this species is ovoviviparous. Hay[35] (p. 397) discovered a female with 5 embryos. Strecker (p. 50)[36] has a specimen with seven embryos, and Ditmars (1907, p. 272) records that a captive "gave birth to seven young on the 20th of August." This lone female, secured June 15, 1912, has six embryos. These masses in length range from 15-18 mm.; in width from 6–7 mm. The membrane about each is practically transparent; the embryo lays in the middle of one side presenting an apparent cephalic and caudal yolk mass which actually on the opposite side proves continuous from one end to the other.

In this species we discovered no parasites, external or internal,

"As at present known, the range of *sackeni* is confined to the southern part of the coastal plain, in southern Mississippi and Florida. This physically recent feature with its low altitude (nowhere more than a few hundred feet above sea level) is characterized by scores of stagnant rivers, lakes, lagoons and swamps. The temperature and humidity are high and the rainfall-evaporation ratio exceeds 110 per cent. (Transeau, 1905). The vegetation is rich, and consists of such forms as white cedar, sweet bay, magnolia, tupelo gum, swamp cottonwood, cypress, *Quercus texana*, etc., in the swamps, and several species of pines on the higher ground. As far as I have been able to find, the form has never been recorded outside of Florida, although Ditmars (1907, p. 219) states that it is distributed in the 'coast regions of South Carolina and Georgia; Florida generally.' Certainly, typical *sackeni* may be expected to occur somewhat north of the latitude of the northern boundary of Florida, but in this general region it comes in contact with *sauritus*, and the status of the two forms in the intermediate region must be examined before the northern boundary of *sackeni* can be even approximately fixed. I must confess to have examined but few specimens from the debatable region, but the fact that *sauritus* specimens from the coastal plain from North Carolina northward show a much closer affinity to *sackeni* than those from central Alabama would seem to indicate that true *sackeni* pushes farther up the Atlantic coast than in the interior, possibly into Georgia and South Carolina, as Ditmars indicates, which might also be expected in view of its more aquatic habits and its association with the coastal plain conditions throughout the greater part of its range."

Coloration.—A color description of a live specimen captured on Billy's Lake is as follows:

The venter is opalescent with an opalescent coppery brown on the ends of the gastrosteges. In water the two lower rows of scales look greenish-brassy and the lateral stripe straw-colored. The row above the lateral stripe is bordered by a line of black specks; the back scales are olive and the dorsal row, much like in color the two lowest side rows, is defined on either side by fine black specks. The dorsal row is practically absent on the caudal two-thirds of the body. Black postocular stripe over the upper labials. Three other specimens in life did not impress us as rich brown or dark as *T. sauritus* and appeared more slender.

Supplementary notes of color from alcohol and formol specimens are: In some specimens, the dorsal stripe extends to a position

opposite the anus; in one individual also along the tail; in most, however, it is prominent only on the neck. Nowhere does it have the color of the lateral stripes except possibly on the neck region. When the body is distended the intervals between the scales have regular light specks or lines as *T. sauritus.* Rarely the lateral stripes become more or less obscure, but not wholly absent. The dorsal stripe covers the median dorsal rows and two half rows and the lateral stripe is on the 3d and one half on the 4th row of scales.

Dimensions and Variations.—The specimens vary in length from 31–71.5 cm. (12½–28 inches). The latter length compares favorably with *T. sauritus* lengths, but the specimens may average smaller than that species, though the average of the ten specimens is 48 cm. (19½ inches). The extreme slimness of the species adds to its diminutive appearance. The tail ranges from 11.2–23.5 cm. in length or 2.9–3.25 (average 3) times in the total length. The gastrosteges vary from 149–159, average 154, where Ruthven's extreme begins and almost coincident with his lower extreme for *T. sauritus.* In all

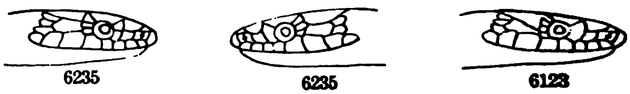


Fig. 13.—*Thamnophis sauritus sackeni* (Kenn.).

the anal plate is entire. The urosteges range from 95–114, in better accord with the range of Ruthven's *T. proximus* and far below his range for *T. s. sackeni.* The scale formula is 19–19–17, except in one where only 19–17–17 obtains. The oculars are 1–3 except in two instances, in one specimen (No. 6,123) they are 1–4 on both

River, in the moist situations of the wooded parts of the islands, if not also in the dense cypress thickets. It is beautiful and is extremely lithe of body. It frequents the edges of the little "houses" or islets on the prairies, coursing among the water plants like a true water snake. Of its expert swimming ability we had one fine illustration. On the widest part of Billy's Lake we noticed a small snake several rods ahead. It was halfway across in its course. We raced to head it off, and swift and straight it did make its course. It had almost reached the other shore when one of us hit at it, only to see it dive deftly. It remained under water for a short time and soon reappeared on its back trail. We circled slowly towards it and when near it stopped. It came immediately to the boat, apparently more from curiosity than from exhaustion. This species must be accredited with very good aquatic skill and endurance.

Food.—Its food is mainly small aquatic animals. In one specimen were insect remains. Frogs seem to be a prominent food with this species. Four of the ten had eaten frogs, one having two southern meadow frogs (*Rana pipiens sphenocephala*) in its stomach and another had one of this same species. Another snake had captured the cricket frog (*Acris gryllus*) and a fourth had eaten a pine-wood's tree frog (*Hyla femoralis*), all these frogs except the last suggesting an aquatic foraging ground for the species. Besides the frogs, there were indications that they occasionally eat fish and other animals of the water.

Breeding.—Three specimens taken in the early part of July showed the egg development to be not far advanced. One had 5 eggs, another 8 and one 10. The number of young of this ovoviviparous snake is comparatively few and must be born in late summer or early fall.

Parasites.—This species and its relative, *T. sirtalis ordinatus*, were badly afflicted by internal parasites. In one specimen there were parasites in the stomach, others partly in the abdominal cavity and partly through the peritoneum and still others solely between the peritoneum and the skin. In another specimen these occur in the cephalic region and appear from the outside like large protuberances. They lie just beneath the skin or imbedded in the muscles.

17. **Thamnophis sirtalis ordinatus** (Linnæus): "Highland Moccasin"; Garter Snake; Common Garter Snake; Grass Snake; Little Green Grass Snake; Spotted Garter Snake.

The garter snake is common in the swamp, and the local name. "highland moccasin," indicates that the natives consider it more upland and terrestrial than the *Natrices* or *Thamnophis s. sackeni*.

Coloration.—The specimens at hand all correspond very closely with *T. sirtalis ordinatus* (Linnæus), though our use of the subspecific name above does not commit us to full recognition of the worth of this subspecies. The lateral stripe is absent or very indistinct in one or two specimens. The dorsal stripe is very distinct in only one specimen (No. 6,221). In all the others it is entirely absent or indistinct. In some specimens the three rows of spots of each side show very beautifully; on the venter the snakes are bluish-gray, except for the throat and chin which are yellowish-white. There is a black spot near the end of each gastrostege. In some specimens the cephalic gastrostegal borders are black and thus connect the gastrostegal spot of either end of the gastrostege. In two specimens these spots are practically absent or obscured. One example, the largest, is melanistic in appearance and the end of each gastrostege and its gastrostegal spot is covered with the dark body color. In all the supralabials are dark edged, but the infralabials are immaculate except in two or three of the largest specimens, where there are dark edges as on the supralabials.

Dimensions and Variations.—The fifteen specimens vary in length from 32.7–78.2 cm. ($13–28\frac{1}{2}$ inches); the tail is 7–17.6 cm. or $3\frac{9}{10}$–$4\frac{4}{5}$ in the total length (average $4\frac{3}{10}$); the gastrosteges have a small range from 136–146, or average 141 (ten of the fifteen have 141 or 140); the urosteges are 66–77, or average 70. The scale rows are very constant, being 19–19–17, except in No. 6,223 where they are 19–19–15; the supralabials 7; the infralabials 10 except in one case of 11. In all the loreal is present and the oculars are consistently 1–3, except in two specimens where they are 1–4 on one side; six of the specimens have the temporals 1–2 on both sides, one specimen 1–3

toad (*Bufo l. lentiginosus*) proved the prey. Two others had eaten the narrow-mouthed frog (*Engystoma carolinense*) and the pine-wood's tree frog (*Hyla femoralis*). In two specimens many small beetles were found in the stomachs with the frogs and one had nothing but beetles. All except one of the specimens with food had Anura, and beetles seemed the second important food of this species.

Parasites.—Three of these snakes were afflicted with internal parasites. The natives call this species "highland moccasin," because of its habitat and because of its supposed poisonous nature. Certainly, it is strange that in their crude way this observing and simple people should have associated it with *Tropidonotus*, as they surely do in calling it "highland moccasin," in contradistinction to "water moccasin."

18. Ancistrodon piscivorous Lacepede: "Moccasin"; "Green-tailed Moccasin"; Water Moccasin; Cotton-mouth Moccasin; Cotton-mouth; Stump-tailed Moccasin. Fig. 14.

The water moccasin is common in the swamp. In the three collections from the swamp we have sixteen specimens, seven taken between May 29–July 15, 1912, seven from July 15–November 1, 1912, and two taken in the fall of 1913.

Coloration.—The smallest specimen taken, measuring 38.3 cm., shows a decided similarity to *A. contortrix* in coloration, only the body color is more brownish than the light brown or drab of the copper-head. There are thirty-two vertical bars in twos, these individual bars being one or two scales wide. In the cephalic half of the body two bars of one side alternate with two of the other side. Two bars form a diamond inclosing an area of the lighter body color. In this lighter area there is usually a small spot of color like the bars. In the caudal half of the body the two bars of one side may be opposite two of the other side and unite across the back, making a cross-band. On the tail are seven cross-bands. The caudal half of the tail, both dorsum and venter, is greenish-yellow in this small specimen. This stage of the moccasin the natives consider another species, "the green-tailed moccasin." Opposite the intervals between two sets of bars and opposite the space inclosed by two bars there is on the end of the gastrostege a black spot 1½ the width of the gastrostege. In the front half of the body the black spots of one side of the venter alternate with those of the other side. In the caudal region where the sets of bars are opposite each other as are the intervals, these gastrostegal spots also are opposite, merge and are not so conspicuous. As the snakes get older the dark ventral blotches become less distinct and the yellow or yellowish-white ground color of the venter

more dominant, the cross-bands of the back almost disappear or persist last in the cephalic half of the body, also occasionally near the anus. In all (except two) of the large specimens the tail is perfectly black on the venter, and this usually extends ahead of the anus for 20–30 gastrosteges; in one large specimen (No. 6,214) the same ventral area both ahead of the anus and on the underside of the tail was merely heavily blotched with black. In the young specimens the labials are heavily marked with rich brown which is more or less obscure in adults. Usually the upper labials in the adults are immaculate or with few dark spots, but the infralabials retain more or less of the brownish markings of the young stage. The postocular brown band bordered below by the yellowish labial line and above by a pale streak is persistent in all.

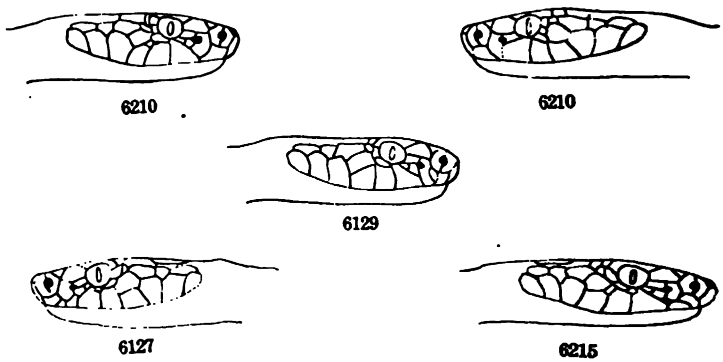


Fig. 14.—*Ancistrodon piscivorus* Lacep.

Dimensions and Variations.—These specimens vary in length

to *Toxicophis pugnax* B. and G. is carried even closer in several. In No. 6,210 with 7–8 supralabials the triangular point of the second labial has been forced just above the labial border on the right side and on the left side just reaches it; in Nos. 6,213 on the left side and 6,133 on the right side it enters the labial border, while in No. 6,129 the point is just excluded from the border. The infralabials range from 10–11, the latter number predominating. Besides the inferior loreal, this species occasionally has another loreal in front of the pit, as in the copperhead, and the absence of this plate is not so constant for *A. piscivorus* as it might be thought. In No. 6,215 it appears on both sides cut off from supralabial No. 2; in No. 6,127 it appears on the left side; in Nos. 6,130 and 6,132 it is on the right side. Thus, in five of the sixteen this distinguishing character between *A. contortrix* and *A. piscivorus* appears in the latter. The temporals may be 2–2, 3–3, 4–4, 4–5, 5–4, 6–4, 6–5. The oculars are usually 2–3, though 2–2, 2–4, 3–2, 3–3, 3–4 and 4–3 also occur.

Habits.—The "moccasin" is the Crotaline snake of the swamp. It frequents the thickety edges of the cypress ponds on the islands, occurs around the wooded edges of the water stretches and where the woods of the island's border meet the piney woods, also along the water-courses and quite generally through the swamp. On the prairies they are not so common as in the wet, woody parts. They lie on the little hummocks above the water and slide in at one's approach. The Okefinokee Swamp is no place for the collector who has been reared in harmless snake country where the method of capture is to step on your prey. One of the authors instinctively tried it on a supposed *T. taxispilotus*, and fortunately just missed one of the biggest of the sixteen moccasins captured. They are rather sluggish, yet those who know poisonous snakes handle them very carefully. In spite of the presence of so many moccasins, the children go barefoot. On the hunting trips for bear and deer the men of the Lee family frequently travel all day barefoot, and Mr. Bryant Lee has twice been bitten in the large toe by a moccasin. In such cases, usually the dogs which are ahead avoid the snake, but the hunters immediately behind step on them. In both of these injuries the patient's leg and part of his side swelled to twice their normal proportions. He recovered from both experiences. These simple people could find no cure for it and in the second case thought some "Cuban relief" efficacious. We suspect the ingredients of this nostrum to be alcohol, although we are not positive of it. The presence of such creatures as alligators, alligator snappers and

moccasins do not deter the family from swimming. One day our whole camp and the male members of the Lee family took a swim at Billy's Lake landing, and soon a moccasin swam from one hummock to another through the party's midst and the snake was captured as well. In another instance one of the small boys came into camp with a large dead moccasin in one hand and a live spreading adder in the other. Upon inquiry we found that the boys went in bathing in a small pool 2 x 6 feet near their house only to find two large moccasins there before them. One they killed, the other escaped. These side lights which we would think make life precarious shows how the natives view existence in such an environment. None of our specimens is more than 6½ inches in circumference, but the Lees assert that they reach 9 or 10 inches or even more. This snake is dangerous, pugnacious and ill-natured if tormented or pinned beneath a log or pushed into a corner, and care needs to be exercised after your game is supposedly dead, for the striking propensity is one of the last to leave the reflexive dead reptile. As one member of the party, a hater of snakes, said, "After it is dead, give it two more licks for safety's sake."

Breeding.—This snake is ovoviviparous. Two females taken June 10 and 22, 1912, respectively, each (Nos. 6,131, 6,130) had 5 embryos not far advanced. Another taken June 12, 1912 (No. 6,127), had 10 embryos in about the same stage, and another specimen (No. 6,213) taken between July 15 and November 1, 1912, had 5 embryos, some of which were not far from hatching.

Food.—The food of this species is considered to be fish, frogs and other aquatic animals. They seek the transient pools of the islands for stranded killifishes and tadpoles. One individual had a young

Coloration.—In coloration they agree very well with the descriptions for the species, the red vertebral line being very conspicuous, as are the three rows of alternating black spots of either side. The venter is whitish with numerous black blotches and spots.

Dimensions and Variations.—The measurements of the six are as follows:

No.	Gastro-steges	Urosteges.	Total length.	Tail.
6,243	143	27	35.1 cm.	3.7 cm.
6,244	136	36	25.5 "	3.3 "
6,245	132	34	23.5 "	3.5 "
6,246	143	31	48.3 "	6.0 "
6,247	135	33	52.3 "	6.5 "
6,109	146	32	39.5 "	5.0 "

No.	Scales.	Supra-labials.	Infra-labials.	Rattles.
6,243	23-23-20	10-11	11-11	2
6,244	22-21-21	10-10	11-11	1
6,245	21-21-19	10-11	11-11	1
6,246	23-23-17	10-10	11-11	5
6,247	25-23-18	10-10	11-11	3
6,109	25-23-17	10-10	11-11	5

In all the loreal between preocular and postnasal is present; the ocular ring of scales from 6-9 in number; the anal entire.

Habits.—This species apparently appears second in abundance of the four Crotalids recorded in the swamp, the moccasin exceeding it in abundance. It was the first form of the four to be seen and the first specimen was stepped upon and calmly picked up back of the neck by one member of the party, he not being aware that it was poisonous at all.

Breeding.—Like the other poisonous Crotalids this species is ovoviviparous, but the number of young is few, usually from five to nine being the range. One 14-inch specimen (No. 6,243) taken between July 15-November 1, 1912, has eight medium-sized embryos, the caudal one being the smallest. Another, the largest specimen (19 inches long), taken September, 1913, has nine embryos.

Food.—This species is supposed to feed on frogs and field mice. One individual had in its rectum the remains of several beetles, grasshoppers, spiders and the ribs and pieces of skin of a very small snake or lizard. Another specimen had in its stomach the hind legs and tail of the ground lizard (*Lygosoma laterale*), the tail pointing forward. This conforms to the rule with almost all the snakes of the Okefinokee collection. In almost every instance vertebrate

food is swallowed head first. The largest specimen (No. 6,251) had the stomach full of parasites and in the intestine just back of the stomach were a few more.

20. Crotalus adamanteus Beauvais: Diamond Rattlesnake; Diamond-back Rattlesnake; "Rattlesnake."

One specimen was taken during our stay in the swamp. On June 21, 1912, Mr. Jackson Lee secured it in the late afternoon in the Pocket. His dog had discovered it and Mr. Lee "crooned" (threw a chunk) it with a chunk of wood, but the rattles were broken off in the process. The specimen must have been 4½–5 feet long, for the length to the anus is 115 cm. The gastrosteges are 181; anal entire; scales 29–27–21; three rows of scales between suboculars and labials; seven rows between supraoculars which are transversely ridged; loreal, one on the right side and two on the left side. Two or three other diamond-backs were killed on the west border of the swamp near Fargo while we were in the swamp.

This largest of our poisonous snakes proves a serious economic factor to the inhabitants of Okefinokee Swamp. The Lees assert that in 1910 alone they lost 10–15 head of hogs killed by this species and other rattlers. In some seasons the rattlers and bears combined compel the Lees to go outside the swamp for new hog stock. They further contend that hogs are not wholly immune, but that the hogs will eat dead rattlers, preferring the heads. At other times they eat the heads first and later the body, or in some instances the whole snake at once. They are not so certain that the hogs are such mortal enemies of the rattlers as they are reputed to be. In some seasons the rattlers are very common; during the season of 1912 they were scarce, as the one capture shows. They occur throughout

snake was about 5 feet long. In the collection made by Messrs. Jackson and Lemuel Lee, July 15–November 1, 1912, we have a fine specimen. The other specimen was secured in the fall of 1913 by J. C. Bradley and Paul Battle.

Coloration.—The coloration of the larger specimen (No. 6,255) is a pinkish-gray. In the cephalic end of the body there is on either side of the back and sides a series of three rows of alternate spots for a distance corresponding to four zigzag bands. The upper row of each side is separated from the one of the other side by a reddish-yellow band 3 scales wide which runs along the middle of the back for quite a distance until the chevron bands begin. Then it continues along the back between the chevron spots almost to the anus. This dorsal band shows better in the small specimen (No. 6,250). Beyond the series of three rows of alternating spots on the neck region come three bands which have not the lower row of spots united with them. Then follows 18 zigzag cross-bands to the anus and 4 on the tail, which is not completely black. The first of these four does not completely encircle the tail as the subsequent ones do. In the smaller specimen there are 5 black bands on the tail, the first three not complete on the venter, and ahead of the anus there are 26 bands, six of which are not wholly united. The median point of the chevron is directed backward and the angle on the sides points forward, the latter point usually being on the 7th–9th row of scales. The black bands are 2 scales wide and the ground-color intervals 5–6 scales wide. Occasionally half black bands appear with no counterpart on the other side. The venter is lighter than the back, yet heavily speckled with the ground color of the back. These specimens well agree with the so-called canebrake form of the South.

Dimensions and Variations.—The total length of the larger specimen is 118.7 cm., the tail 14.5 cm., or $8\frac{1}{2}$ in the total length, and with 14 rattles; anal entire; gastrosteges 178; the urosteges 22; scales 26–24–20; oculars 7; supralabials 14, the 4th the largest; infralabials 18 on the right side and 17 on the left side; two loreals. The smaller specimen is 38.5 cm. long; the tail 3.3 cm., or $11\frac{2}{3}$ in the total length; anal entire; scales 27–(23–25)–21; orbital ring 8 on one side and 7 on the other side; infralabials 14. In both specimens there are three rows of scales between the eye and the supralabials; the larger specimen has the first row of body scales smooth.

The natives described to us a large rattler as large as a diamond-backed rattler and called it the "Siminole rattler," which we pro-

visionally identified as *C. horridus*, and later Prof. J. C. Bradley's capture verified this identification in the fall of 1913. On Mixon's Hammock, June 16, 1912, we also found beneath an old roof on the ground the cast skin of this species.

Explanation of Plates I–III.

Plate I.—Fig. 1.—Carapace of *Platypeltis ferox*.
Fig. 2.—Carapace of *Platypeltis ferox*.
Fig. 3.—Skull of *Macroclemmys temminckii*.
Fig. 4.—Skull of *Platypeltis ferox*.
Fig. 5.—Skull of *Chelydra serpentina*.

Plate II.—Fig. 1.—Eggs of *Alligator mississippiensis*.
Fig. 2.—Eggs of *Cnemidophorus sexlineatus*.
Fig. 3.—Eggs of *Cinosternum pennsylvanicum*.
Fig. 4.—Eggs of *Chrysemys floridana*.
Fig. 5.—Eggs of *Chelydra serpentina*.
Fig. 6.—Eggs of *Platypeltis ferox*.

Plate III.—Fig. 1.—Ovarian egg of *Diadophis punctatus*.
Fig. 2.—Ovarian egg of *Elaphe obsoletus*.
Fig. 3.—Ovarian egg of *Cemophora coccinea*.
Fig. 4.—Embryos of *Haldea striatula*.
Fig. 5.—Egg of *Coluber constrictor*.
Fig. 6.—Egg of *Chrysemys floridana*.
Fig. 7.—Ovarian egg of *Heterodon platyrhinus*.

APRIL 20.

MR. CHARLES MORRIS in the Chair.

One hundred and thirty persons present.

The Council reported that Dr. Spencer Trotter had been appointed a member of the Library Committee to fill the vacancy caused by the death of Dr. Thomas Biddle.

The Publication Committee reported the reception of papers under the following titles:

"A further contribution to the knowledge of the Orthoptera of Argentina," by James A. G. Rehn (April 1).

"The earliest Samoan prints," by William Churchill (April 7).

MR. THEODORE JUSTICE made a finely illustrated communication on the evolution of the horse.

The following were ordered to be printed:

PRATICOLELLA.

BY E. G. VANATTA.

An examination of the anatomy of several United States land mollusks, which were supposed to belong to the genus ***Polygyra***, has made it necessary to transfer them to the genus ***Praticolella***. The species may be distinguished as follows:

Praticolella griseola (Pfr.).

Helix griseola Pfr., Symb. Hist. Hel., I, p. 41 (1841).

This is a white shell with spiral brown bands, a thin lip, and obscure microscopic spiral striæ upon the apex. The anatomy is unknown.

Praticolella berlandieriana (Moric.). Fig. 1.

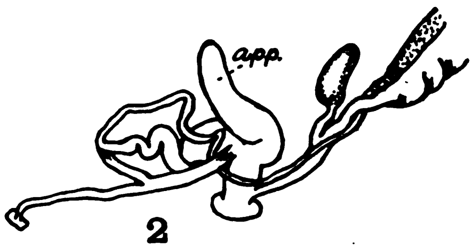
Helix (Helocogena) berlandieriana Moric., Mem. Soc. Hist. Nat. Geneve, VI, p. 537, pl. 1, fig. 1 (1833).

A species similar in color and sculpture to the preceding, but with a very thick lip. The genitalia (fig. 1) of a specimen in the collection of The Academy of Natural Sciences, No. 76,209, from Victoria, Tex., collected by Hon. J. D. Mitchell, has a very long, hollow, finger-shaped, somewhat glandular appendix upon the penis. The verge is shorter than in *P. pachyloma* Mke. The penis retractor is

Praticolella pachyloma (Mke.). Fig. 2.

Helix pachyloma Mke., Zeitsch. für Mal., IV, p. 32 (1847).

This shell is globose, translucent corneous, with a white lip and very obscure microscopic spiral striæ on the apex. The genitalia (fig. 2) of a specimen, No. 104,754, A. N. S. Phila., from Seabrook, Tex., collected by Mr. H. H. Wenzel, has a rather short, hollow, finger-shaped, somewhat glandular appendix. The verge is long



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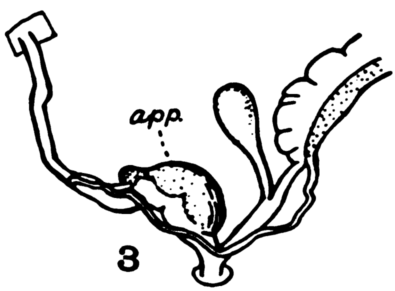
and much folded. The surface of the interior of the phallus and the penial gland is granular and without longitudinal plications. The penis retractor has two subequal branches, one united to the apex of the verge and the other attached at the base of the penial gland. The vas deferens is long, folded and bound to the phallus by the branch of the retractor muscle at base of the appendix. The spermatheca bulb is reniform.

Praticolella mobiliana (Lea). Fig. 3.

Helix mobiliana Lea, Proc. Amer. Phil. Soc., II, p. 82 (1841).

It is usually smaller and more depressed than the preceding species, and is translucent brown, with a deep groove back of the broadly reflexed lip which often has a reddish tinge. The apex has very obscure microscopic spiral striæ. The genitalia (fig. 3) of a specimen in the Academy's collection, No. 106,000, from near Mobile, Ala., collected by Mr. H. P. Löding, has a conical penis with a padlike penial gland on one side. The retractor muscle is attached to the apex of the penis. The vas deferens is rather short. The thin-walled phallus and its appendix are longitudinally corrugated within; the convex side of the penial gland is glandular as in *P. pachyloma* Mke., but it is not



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long and finger-shaped. I propose a new section, ***Farragutia,*** for this species.

Praticolella mobiliana floridana n. var. Figs. 4, 5, 6.

This is a form which differs from the typical *P. mobiliana* Lea by having a peculiar callus on the lip, as shown in the figures.

Alt. 4.6, diam. 6.8, apert. alt. 3.1, diam. 3.9 mm. Type number 11,445, A. N. S. Phila., from Volusia County, Florida, collected by Mr. G. W. Webster (1892); also in the collection from Jacksonville, Fla., collected by Morgan Hebard and James A. G. Rehn (August 25, 1911). The structure of the genitalia is unknown.

Praticolella bakeri n. sp. Figs. 7, 8, 9.

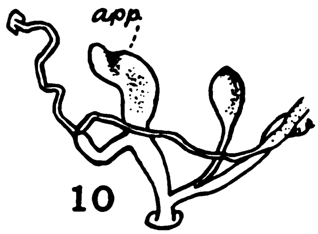
Shell globose, translucent, corneous, rather grayish above the periphery; spire moderately elevated; whorls 5; suture impressed; surface rather dull, with irregular growth striæ, indistinct spiral lines and peculiar oblique microscopic lines; apex obtuse, with obscure

differs from *P. pachyloma* Mke. by the sculpture of the apex and the shallower groove back of the peristome. Unfortunately, the animal was lost, but from notes made at the time of cleaning the shell, the genitalia were similar to those of *P. jejuna* Say, but with a very short finger-shaped penial gland.

Praticolella lawæ (Lewis). Fig. 10.

Helix (*Mesodon*) *lawii* Lewis, Proc. Acad. Nat. Sci. Phila., 1874, p. 118.

This species has a pustulate apex and a parietal tooth. The genitalia (fig. 10) of a specimen in the collection of the Academy, No. 90,722, from Calera, Ala., collected by Mr. H. H. Smith and presented by Mr. G. H. Clapp, has a hollow penial gland. The verge is rather short and abruptly folded at the insertion of the appendix and half way between this point and the attachment of the long retractor muscle at the apex. The vas deferens is rather short. The interior of the verge and the hollow penial gland is longitudinally corrugated, while the convex side of the appendix is thick, and granular on the inner surface. The spermatheca bulb is oval.



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Praticolella lawæ tallulahensis (Pils.).

Polygyra lawæ tallulahensis Pils., Nautilus, XII, p. 22 (1898).

This shell has a pustulate apex, the peristome is much like *P. mobiliana* Lea. The anatomy is not known.

Praticolella jejuna (Say).

Helix jejuna Say, Jour. Acad. Nat. Sci. Phila., II; p. 158 (1821).

This is a smaller shell than *P. bakeri*, having a diameter of 5–6 mm., with 10 or 12 spaced spirals on the apex; the lip is white and not reflexed. The genitalia have been figured in the *Nautilus*, XX, p. 33 (1906). The penis retractor has one attachment at the apex of the phallus, and the penial gland is very long and finger-shaped.

Praticolella jejuna clavis n. var.

This shell differs from *P. jejuna* by being larger, white and has 5 whorls.

Alt. 5.5, diam. 8 mm.

Types No. 100,126, A. N. S. Phila., collected by Dr. H. A. Pilsbry on No Name Key, Florida, in 1907.

All these shells have a peculiar oblique microscopic striation on the surface of the newer whorls.

Of several other names which have been placed in the synonomy by various authors, it should be explained that *Helix cicercula* Desh. [not Gld. 1846] in Fer. Hist., I, p. 390, IV, pl. 107, figs. 4–10 [1851], figs. 4–6 are *P. griseola* Pfr., and figs. 7–10 are *P. pachyloma* Mke.

Bradybæna pisum Beck, Index Moll., p. 18 (1837), and *Helix splendidula* Anton, Verz. d. Conch., p. 36 (1839), are not accompanied with a diagnosis.

Helix albocincta Binney (1841), *Helix albolineata* Gld. (1847) and *Helix albozonata* Binney (1847) are various names for the same shell in Binn. Ter. Moll. U. S.

Helix virginalis "Jan." Pfr., Zeitsch. für Mal., 1848, p. 115, judging from Reeve's figure, is a white, slightly carinated shell and may not be a *Praticolella*.

THE EARLIEST SAMOAN PRINTS.

BY WILLIAM CHURCHILL.

The ethnica of the Wilkes Exploring Expedition (1837–1841) underwent a series of disasters of such gravity that it is surprising that anything was preserved. The official collections, known to have been of great magnitude and unrivalled importance, were lost in the wreck of one of the vessels of the squadron on the Columbia bar in Oregon. A surrogate collection was hastily assembled by Wilkes by annexing the specimens which had come into the possession of officers and men. This second and inferior collection reached Washington in 1842, vanished from sight for fifty years and was not discovered until 1892,[1] when I had the melancholy pleasure of installing in the National Museum all that had survived the decay of half a century. All the perishable materials had by that time gone into the end-products of decomposition.

When the squadron put into Botany Bay, after completing the survey of the islands from Tahiti to Fiji, the members of the civilian scientific staff were landed as a matter of convenience, while the naval officers went upon their dash toward the South Pole and the discovery of Antarctica, only recently confirmed. In the civil staff was Titian R. Peale, a young member of an old and respectable family of Philadelphia. It is through him that The Academy of Natural Sciences of Philadelphia is in possession of one of the best collections of Polynesian ethnica anywhere in the world. Others are larger, but none is so seriously representative of the period before foreign contamination had been introduced. The records show little of the manner in which Peale's collection escaped the commandeering by Wilkes after the disaster at the Columbia; but it is evident that Peale landed his treasures when he went ashore at Botany Bay and that thence he secured transport by way of London to the United States. In due course of time he deposited these important objects with The Academy of Natural Sciences of Philadelphia, in his home town, where now they are displayed in a satisfactory manner and are available through the courtesy of the Academy for purposes of study.

[1] It had been placed in the cellar of the Smithsonian Institution and buried under many tons of incombustible coal.

Specimen No. 10,615 in the Peale Collection is a pile of small basketry from Samoa, half a dozen pieces of the common envelope type still in Samoan use. It is labelled "School Satchel." In connection with the date, 1839, this label led me to comment that at that time it would be somewhat proleptic to use the designation School Satchels, in view of the fact that the mission had then scarcely secured a foothold in Samoa. In continuation I informed the Curator that basketry of that size and form was intended to hold leaf tobacco and dry banana leaves for cigarettes, for I have been assured by James Dwight Dana that tobacco was found indigenous in the South Sea. Handling the satchel which lay on top of the heap, I noticed that it weighed more than I should expect, and that led to my discovery of printed matter contained therein.

So far as my information extends, these pieces of printed matter are absolutely unique. I have assured myself that they do not exist in mission collections in Samoa, nor yet at the home of the London Missionary Society; they are not in the British Museum, nor can I find them of record in any library custody. It is an inference, but there is much to commend it, that these pieces constitute a complete collection of Samoan prints up to the time of the visit of the Wilkes expedition in 1839. It would appear that Peale displayed an interest in the work of the mission, and a natural response on the part of those who were laboring in that field would be to supply as complete a collection as possible to show what they had already accomplished.

The following memoranda will serve to identify the several pieces in necessary bibliographic detail:

(1) E Mou | Imene | o lea foi le | Talafaalelei | i le | ATUA | ua imene i latou imene. Mataio. | Huahine | Neia i te nenei

Four signatures of 12 pages, one signature of 8 pages, 112 x 184 mm.

(4) O | le Upu | ia | Iosefa | na faamatalaina | o le upu Samoa. | Faapefea le taulealea i le faamama i lona savaliga? ia | toaga lelei iai, ia tatau i lau upu. Davida. | Rarotoga | Printed at the Mission Press 1837.

This is unbound and consists of two signatures of 12 pages each and one of 8 pages. It measures 117 x 190 mm.

(5) O Iesu Mesia Aruna Moni.

Leaflet of four pages, 110 x 171 mm.; footline on page 4: Rarotoga. Printed at the Mission Press. October, 1837.

(6) Isi Nei | SALAMO | a Tavita | (on footline) Upolu:—Printed at the London Missionary Society's Press M.DCCC.XXXIX.

A single sheet broadside, 278 x 437 mm., containing Psalms 117, 122, 128, 130, 121, 131, 133, in two columns.

(7) O | le Uluai Tusi | ma | Tama iti | (ornament of children supporting X Commandments) "Ina aoao ia i a outou fanau." O Mose. | Upolu:— | Printed at the London Missionary Society's Press. | M.DCCC.XXXIX.

Pamphlet of 16 pages, 118 x 171 mm., bound in paper cover.

(8) O le Tala | i | Lotu ese ese | (ornament of X Commandments) "E tasi lava le Alii, e tasi le faalogo, e tasi | le papataizoga." O Paulo i Efesia. | Upolu:— | Printed at the London Missionary Society's Press. | 1839.

Stitched, 12 pages, 105 x 178 mm.

(9) A | Matua Vosa | Vakaviji.

Four pages of alphabet, numerals, and spelling exercises.

And

A | Kosipeli | i | Maciu

This is a mutilated copy: signature 1 has lost pages 5–8, leaving torn edges. The signature was made up in duodecimo and on page 12 is the footline, Printed at the Wesleyan Mission Press, Vavau, Feb. 1838 (W. A. | Brooks. The second signature continues Chapter VII of Saint Matthew's Gospel at verse 7 and runs through pages independently numbered 1–6, the remainder torn out.

Both the foregoing titles are bound in a stiff paper cover, blue on pages 1 and 4, the white inner pages 2 and 3 show parts of a catechism or book of Bible questions in Fijian containing pages 10, 15 and 18 complete, together with the upper six lines of pages 11, 14 and 19.

These prints are interesting as showing the movement of the press in the South Seas. We note the items.

Huahine imprint. The first press in the South Seas was brought to Tahiti by the London Missionary Society about 1818 on the restoration of their work following the failure of the first settlement of the party which was sent out to Tahiti, Tonga and the Marquesas on the Duff in 1799. The first three items in this list do not, therefore, represent the first product of the press in Tahiti, for a considerable mass of literature had by 1837 been accumulated in Tahitian. But they do show that when the need first arose for religious prints in the evangelization of Samoa, it was necessary to employ the Tahiti press at Huahine as being the only one accessible. John Williams began his mission in Samoa in 1835 by a brief visit and returned in 1837; it is clear that the first three items were the product of his learning somewhat of the Samoan language in his first visit and that on his return to Tahiti he made this provision for his permanent settlement.

Rarotoga imprint. A second and better press was received in Tahiti in 1837 and the old machine then became available for the new mission in Rarotonga which had been established by John Williams on his way to Samoa in 1835. To this we owe items 4 and 5.

Upolu imprint. A new press was sent out from London in 1839 for the Samoan mission, and the Rev. John B. Stair was detailed to that field because of his knowledge of practical printing. It is not unreasonable to infer that the broadside of Psalms (item 6) is the first sheet run off the Samoan press, and that item 7 was the next, for we note that these two items use Roman numerals with points for the date and that it is not until we reach item 8 that we find Arabic numerals. That the Samoan printery was fairly well equipped we observe from the fact that items 7 and 8 are the only ones stitched or covered in the Polynesian series.

NOTES ON NEMATOGNATHOUS FISHES.

BY HENRY W. FOWLER.

The present account comprises an annotated list, with descriptions of several new species, belonging to the Ostariophysian order Nematognathi, contained in the collection of the Academy.

SILURIDÆ.

TACHYSURINÆ.

Felichthys pinnimaculatus (Steindachner).

One from Panama.

Felichthys marinus (Mitchill).

Harvey Cedars, Great Egg Harbor, Corson's Inlet, Sea Isle City, New Jersey; Wounta Haulover, Nicaragua.

Galeichthys felis (Linnæus).

Bayport and Big Pine Key, Florida.

Selenaspis herzbergii (Bloch).

One example 137 mm. long from Dutch Guiana (Dr. C. Hering). This closely resembles *Hexanematichthys hymenorrhinus* Bleeker[1] from "Guatimala," a species not included in Regan's work on Central American fishes, and usually merged with the present as a synonym. My specimen agrees largely with Bleeker's figure of *H. hymenorrhinus*, though he does not show the lateral line with subequal, short, backwardly directed branches along its lower edge. The teeth are shown differently on the palatines, as in my specimen they are in enlarged and more approximate areas. My example shows the internasal cutaneous ridge incomplete or only developed at the sides, and the gill-rakers 8+15, while Eigenmann and Eigenmann give but 6+10 for *S. herzbergii*.

Another example, young, from Paramaribo, Dutch Guiana (Dr. C. Hering), representing *Netuma dubia* Bleeker. It has a distinct cutaneous ridge uniting the hind nostrils, a character not shown in Bleeker's figure.[2] The maxillary barbels are also shorter, and do not quite reach to the ventrals.

[1] Mém. Soc. Holl. Sci. Harlem, 1864, p. 57, Pl. 11, fig. 2, Pl. 13, fig. 4.
[2] *L.c.*, p. 63, Pl. 13, fig. 5, Pl. 15, fig. 2.

Netuma thalassina (Rüppell).

Two from Padang, Sumatra.

Netuma aulometopon sp. nov. Fig. 1.

Head $3\frac{3}{4}$; depth $5\frac{1}{4}$; D. I, 7; A. vi, 13; P. I, 10; V. i, 6; head width $1\frac{1}{3}$ in its length; head depth at occiput $1\frac{4}{5}$; snout $3\frac{1}{6}$; eye 5; maxillary $3\frac{1}{8}$; mouth width $2\frac{1}{2}$; interorbital 3; antero-internasal 4; dorsal spine $1\frac{3}{5}$; first branched anal ray $1\frac{7}{8}$; least depth of caudal peduncle $3\frac{3}{5}$; pectoral spine $1\frac{1}{2}$; ventral fin $2\frac{1}{6}$.

Body compressed, rather slender, deepest at dorsal origin, and edges all convex. Caudal peduncle well compressed, least depth about half its length.

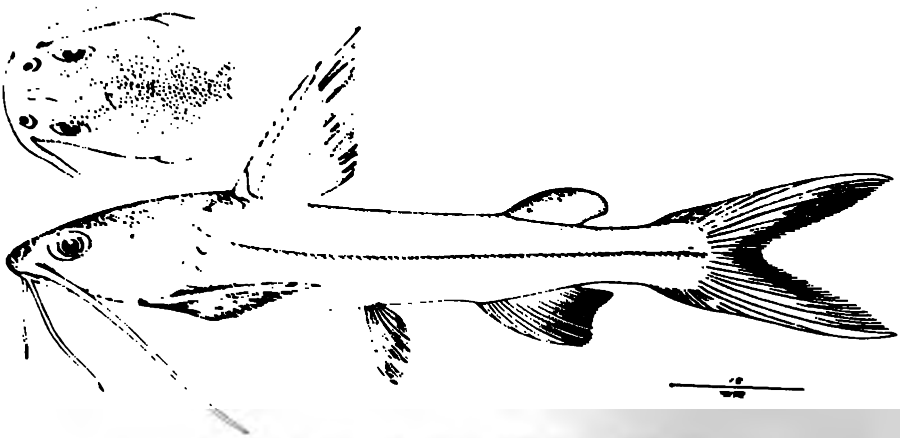

Fig. 1.—*Netuma aulometopon* Fowler. (Type.)

Head convex above, flattened below, and upper profile slightly

Interorbital broad, depressed. Fontanel well developed, broad in front where it begins opposite hind nostrils and continues to occipital plate, or about half space between snout tip and dorsal origin. Occipital, parietal and predorsal plate more or less rugose. Humeral process extends not quite to middle of pectoral spine, smooth and mostly swollen in front. Opercle broadly triangular, smooth.

Gill-opening extends forward nearly opposite hind pupil edge. Rakers 4+13, firm, lanceolate, simple, about $\frac{2}{3}$ of filaments, and latter $\frac{2}{3}$ of eye. No pseudobranchiæ. Branchiostegals 6, slender.

Body covered with smooth skin. Head rugose, as previously described. Spines mostly with fine lengthwise keels or striæ. L. l. slopes down from shoulder till midway along side, mostly simple or with many pores all along its lower extent. Back and sides also with vertical series of pores. Axillary pore of pectoral distinct.

Dorsal origin at first third in combined head and trunk length, spine serrate along both edges and nearly straight, and first branched ray longest. Adipose fin inserted little nearer caudal base than origin of dorsal, large. Anal inserted little before dorsal, or at first third between ventral origin and caudal base,. first branched ray longest. Caudal well forked, slender lobes pointed, equal head. Pectoral reaches $\frac{2}{3}$ to ventral, spine nearly straight and both edges serrated. Ventral inserted slightly nearer caudal base than snout tip, and fin extends $\frac{2}{3}$ to anal. Vent slightly closer to anal than ventral origins.

Color in alcohol light brownish generally, slightly paler below, and most of body with more or less silvery tinge. Fins mostly pale brownish, and edges of ventrals and anal somewhat whitish. Iris silvery. Maxillary barbels pale brown, others whitish.

Length 87 mm.

Type, No. 8,372, A. N. S. P. Dutch Guiana. Dr. Constantine Hering.

Nos. 8,373 to 8,375, A. N. S. P., paratypes, same data. They show: Head $3\frac{3}{4}$ to $3\frac{7}{8}$; depth $5\frac{2}{3}$ to $6\frac{1}{8}$; A. VI, 11 to VI, 14; snout $2\frac{2}{3}$ to 3; length 82 to 84 mm.

This species is related to *Netuma upsulonophorus* (Eigenmann and Eigenmann) from Rio Grande do Sul, in having the vomerine patches of teeth united, though the palatine patches are of greatly different design. The Brazilian species also differs in having the front edge of the dorsal spine with granules.

(Αὐλός, groove; μέτωπον, forehead; with reference to the occipital fontanel.)

Netuma barbus (Lacépède).

Two from Rio Janeiro, Brazil.

CALLOPHYSINÆ.

Callophysus macropterus (Lichtenstein).

Two from Peru, one having been secured between the mouth of the Rio Negro and Peru.

ICTALURINÆ.

Ictalurus furcatus (Le Sueur).

Pimelodus affinis Baird and Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 26. Rio Grande.

No. 8,460, A. N. S. P., cotype of *P. affinis* Baird and Girard. Brownsville, Texas. J. H. Clark. Smithsonian Institution (No. 838).

Ictalurus punctatus (Rafinesque).

Pimelodus notatus Abbott, Proc. Acad. Nat. Sci. Phila., 1860, p. 509. Fort Riley, Kansas.
Pimelodus hammondi Abbott, *l.c.* Fort Riley.

No. 8,449, A. N. S. P., type of *P. notatus* Abbott. Fort Riley, Kansas. Dr. W. A. Hammond.

Nos. 22,065 and 66, A. N. S. P., cotypes of *P. hammondi* Abbott. Same data.

Also many examples from Lake Erie, Battle Creek of the upper Missouri, Pennsylvania (Erie, Kiskiminitas and Beaver Rivers), Virginia (Sinking Creek), Indiana (Wabash River), Minnesota (Mankato), Kansas (Leavenworth), Iowa (Hornick and Ottumwa), Missouri (Brownsville and St. Louis), Arkansas (Judsonia and Greenway), Texas (Little Wichita River, Fort Worth and Del Rio).

quehanna River), Delaware (Wilmington, Mispillion Creek, Laurel), Maryland (Elk Neck, Chestertown), District of Columbia (Potomac River, Washington), Virginia (lower James River), North Carolina, Florida (Bayport), Texas (Helotis).

Ameiurus catus okeechobeensis (Heilprin).

Ictalurus okeechobeensis Heilprin, Trans. Wagner Inst. Sci., I, 1887, p. 18. Kissimee River, Lake Okeechobee, Florida.

Nos. 8,442 and 43, A. N. S. P., cotypes of *I. okeechobeensis* Heilprin. Kissimee River, Lake Okeechobee, Florida. 1886. Prof. Angelo Heilprin.

Ameiurus dugesi (T. H. Bean).

Guadalajara market and river outlet of Lake Chapala, Mexico.

Ameiurus natalis (Le Sueur).

Amiurus bolli Cope, Bull. U. S. Nat. Mus., No. 20, 1880, p. 35. Little Wichita River, Texas.

Amiurus prosthistius Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 132. Batsto River, New Jersey.

Nos. 20,512 and 13, A. N. S. P., cotypes of *A. bolli* Cope. Little Wichita River, Texas. E. D. Cope.

Nos. 20,546 to 49, A. N. S. P., cotypes of *A. prosthistius* Cope. Batsto River, New Jersey. E. D. Cope.

Also a large series from New York (Westport), Pennsylvania (Erie), New Jersey (Pool Tolsoms, Newton's Bridge, Tuckahoe River), Delaware (Millsboro), South Carolina (Manning), Michigan (Oakland), Kansas (Leavenworth), Iowa (Brook River), Missouri (Marshfield).

Ameiurus vulgaris (Thompson).

Lake George, New York.

Ameiurus nebulosus (Le Sueur).

Amiurus mispilliensis Cope, Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 486. Mispillion Creek, Delaware.

No. 8,536, A. N. S. P., type of *A. mispilliensis* Cope. Mispillion Creek, Delaware. E. D. Cope.

Large series from Maine (Mt. Desert), New York (Lakes George and Champlain, Poughkeepsie), New Jersey (Passaic, Lake Hopatcong, Bass River, May's Landing, Petersburg Bridge, Sumner, Turnersville, Repaupo, Camden, Pensauken, Merchantville, Duck Island, Trenton), Pennsylvania (many localities already noted elsewhere), Delaware (Rehoboth), Maryland (Willards, Chestertown), District of Columbia (Washington and Potomac River), Virginia (lower James River), North Carolina (Catawba River), Ohio (Hicks-

ville), Illinois, Missouri (Paw Paw), Texas (San Diego and Wichita River).

Two examples from the Hardy River in northern Lower California show four white mental barbels and the membranes between the fin-rays dusky.

Ameiurus nigrilabris (Cope).

> *Gronias nigrilabris* Cope, Proc. Acad. Nat. Sci. Phila., 1861, p. 231. Conestoga Creek, Pennsylvania.

Nos. 22,082 and 83, A. N. S. P., cotypes of *G. nigrilabris* Cope.

Ameiurus melas (Rafinesque).

> *Amiurus brachyacanthus* Cope, Bull. U. S. Nat. Mus., No. 20, 1880, p. 35. Upper Medina River, Texas.

Nos. 20,527 and 28, A. N. S. P., cotypes of *A. brachyacanthus* Cope.

Many examples from Pennsylvania (Erie, Kiskiminitas River), Ohio (Hicksville), Indiana (Miami River), Minnesota (Lake Whittlesee), Iowa (Ottumwa, Silver Lake), Missouri (St. Joseph).

Ameiurus platycephalus (Girard).

> *Pimelodus platycephalus* Girard, Proc. Acad. Nat. Sci. Phila., 1859, p. 161. Anderson, South Carolina.

No. 8,473, A. N. S. P., cotype of *A. platycephalus* Cope. Anderson, South Carolina. Smithsonian Institution (No. 1,434).

Also example from Catawba River, North Carolina.

Leptops olivaris (Rafinesque).

Pennsylvania (Youghiogheny River), Virginia (Sinking Creek), Texas (Fort Worth).

Noturus flavus Rafinesque.

Pennsylvania (Erie, Two Lick Creek, Cherry Run, Youghiogheny [redacted]

New Jersey (Assanpink Creek, Trenton), Pennsylvania (Millanville, Dingman's Ferry, Delaware Water Gap, Schuylkill River, Holmesburg, Susquehanna River, Conestoga Creek, Lopez, Paradise, Altoona), Maryland (Conowingo, Gynn Oak), Virginia (Sinking Creek), North Carolina (Yadkin and Catawba Rivers), Missouri (Carthage).

Schilbeodes exilis (E. W. Nelson).

Brook River, Iowa.

PIMELODINÆ.

Zungaro zungaro (Humboldt).

Peruvian Amazon.

Rhamdia sebæ (Valenciennes).

Surinam and Peruvian Amazon.

Rhamdia vilsoni (Gill).

Trinidad, British West Indies.

Rhamdia riojæ sp. nov. Fig. 2.

Pimelodus humilis (non Günther) Cope, Proc. Amer. Philos. Soc. Phila., XVII, 1878, p. 674. Rioja, near Moyabamba.

Head $4\frac{1}{5}$; depth $5\frac{1}{2}$; D. I, 6; A. v, 7; P. I, 8; V. I, 5; head width $1\frac{1}{4}$ in its length; head depth at occiput $1\frac{3}{5}$; snout 3; eye 7; maxillary $3\frac{1}{4}$; mouth width $2\frac{3}{5}$; interorbital $2\frac{3}{5}$; dorsal spine 2; first branched anal ray $2\frac{4}{7}$; least depth of caudal peduncle $2\frac{1}{5}$; pectoral $1\frac{3}{5}$; ventral $1\frac{3}{4}$.

Body compressed, elongate, rather slender, deepest at dorsal origin, and edges all convex. Caudal peduncle well compressed, least depth equals its length.

Head depressed, broadly convex above, more or less flattened below, profiles mostly similar. Snout wide, broadly convex over surface, length $\frac{4}{7}$ its greatest width. Eye ellipsoid, close to upper profile and its hind edge little anterior in head length. Eyelids free, not adipose-like. Mouth broad, transverse, and upper jaw slightly protruded. Teeth in villiform bands in jaws, simple, sharply pointed, and bands continuous medianly. No vomerine teeth, though all vomerine and palatine regions with wide-spaced minute papillæ. Tongue wide, thick, fleshy, depressed, not free. Maxillary barbel extends to ventral origin. Outer mental barbel reaches tip of depressed pectoral spine, and inner extends $\frac{3}{5}$ to pectoral origin. Posterior internasal area slightly less than anterior. Anterior nostrils near snout edge, in short tubes. Posterior nostril about first $\frac{2}{5}$ in snout length, with low cutaneous edge. Interorbital

broadly depressed. Fontanel moderate, not extending back beyond hind eye edges. Occipital process extends only for first fourth in space to dorsal origin. Humeral process smooth, extends $\frac{2}{3}$ length of pectoral spine. Opercle broadly triangular, with a few slight radiating striæ.

Gill-opening extends forward about first third in head. Rakers 3+8, firm, lanceolate, simple, about $\frac{4}{7}$ of filaments, and latter equal eye. No pseudobranchiæ. Branchiostegals 6, slender.

Body covered with smooth skin. Head smooth. Spines smooth. L. l. slopes down from shoulder till midway along side. Axillary pore moderate.

Dorsal origin slightly nearer anal origin than snout tip, spine short, slightly curved, smooth and pungent, and first three rays subequally longest. Anal inserted nearly midway between depressed pectoral

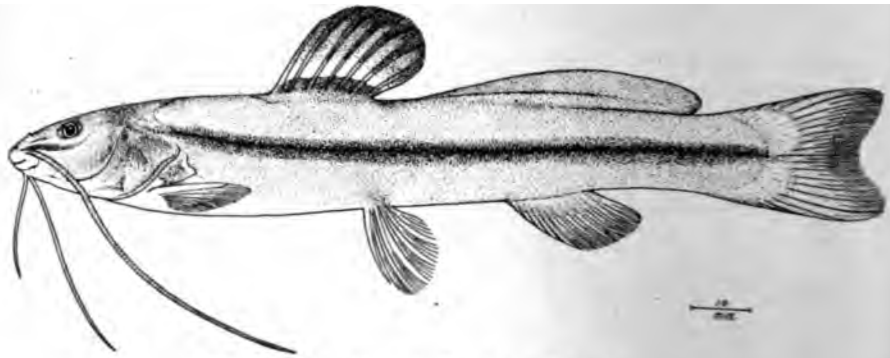

Fig. 2.—*Rhamdia riojæ* Fowler. (Type.)

Puerto, on or near the lower course of the Huallagua River, Peru. 1873. James Orton. Presented by E. D. Cope.

This species seems representative of *Rhamdia quelen* (Quoy and Gaimard) from eastern Brazil and the La Plata, and agrees largely in its long adipose fin. From *R. humilis* (Günther) from Venezuela, with which it was formerly identified, it differs in the longer adipose fin. It also differs from *R. cinerascens* (Günther) from western Ecuador and *R. pentlandi* (Valenciennes) from the Peruvian Andes in similar fashion.

Rhamdia mounseyi Regan,[3] from the Ucayali River, has the occipital process extending $\frac{2}{3}$ to the dorsal origin, the gill-rakers 2 or 3+5 on lower part of arch, and the maxillary barbels extending beyond the anal fin.

(Named for Rioja, the type locality.)

Rhamdia ortoni sp. nov. Fig. 3.

Head $3\frac{4}{5}$; depth $6\frac{1}{5}$; D. I, 6; A. IV, 8; P. I, 8?; V. I, 6; head width $1\frac{1}{2}$ in its length; head depth at occiput 2; snout $2\frac{4}{5}$; eye $5\frac{1}{5}$; maxillary $4\frac{1}{5}$; interorbital $2\frac{7}{8}$; dorsal spine $2\frac{1}{4}$; third dorsal ray $1\frac{2}{3}$; least depth of caudal peduncle $2\frac{2}{3}$; ventral $1\frac{1}{2}$.

Body compressed, elongate, slender, deepest at dorsal origin, and edges all convex. Caudal peduncle well compressed, least depth about $\frac{2}{5}$ its length.

Head depressed, moderately broad, convex above and below, profiles similar. Snout wide, broadly convex over surface, length $\frac{4}{5}$ its greatest width. Eye ellipsoid, close to upper profile and hind edge near middle in length of head. Eyelids free, not adipose-like. Mouth broad, transverse, and lower jaw very slightly protrudes. Teeth fine, villiform, in rather narrow bands in jaws, which contiguous. No vomerine or palatine teeth. Tongue wide, thick, fleshy, depressed, not free. Maxillary barbel extends to ventral origin. Outer mental barbel extends nearly far back as tip of depressed pectoral, inner mental barbel to pectoral origin. Posterior internasal area slightly greater than anterior, and all nostrils simple pores. Interorbital broadly convex. Fontanel large, extends back opposite hind pupil edges. Occipital process extends $\frac{1}{3}$ to dorsal origin. Humeral process rather short. Opercle broadly triangular, with numerous radiating striæ.

Gill-opening extends forward about first fourth in head. Rakers 2+7, firm, lanceolate, several of larger with several denticles, about

[3] Ann. Mag. Nat. Hist., London, (8), XIII, 1913, p. 281.

$\frac{2}{3}$ of filaments and latter $1\frac{3}{5}$ in eye. No pseudobranchiæ. Branchiostegals 5, slender.

Body covered with smooth skin. Head smooth, and small rounded fontanel close before base of occipital process. Spines smooth. L. l. slopes down from shoulder till midway along side. Axillary pore moderate.

Dorsal origin slightly nearer anal origin than snout tip, spine slender, but slightly pungent, shorter than median rays and fin rounded. Anal inserted about last third in space between front eye edge and caudal base, fin small, and median rays longest. Adipose fin moderate, $2\frac{1}{2}$ in combined head and trunk length. Caudal damaged, though evidently forked. Pectoral damaged, spine with lengthwise striæ and not serrated. Ventral inserted about midway

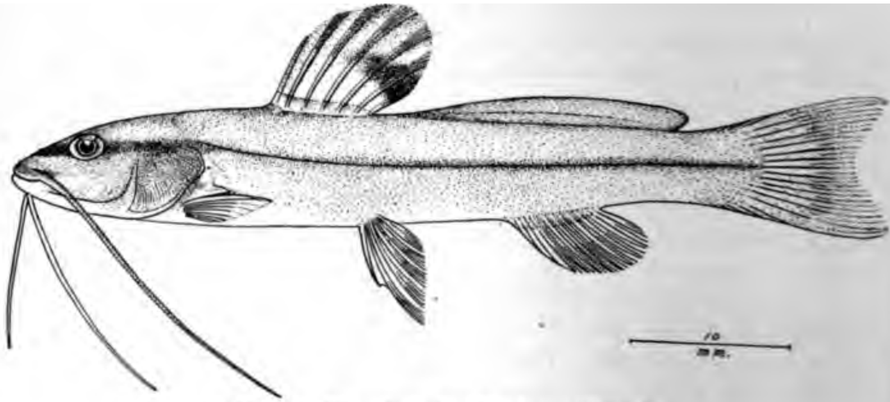

Fig. 3.—*Rhamdia ortoni* Fowler. (Type.)

does not seem likely to be the young of that species. From *R. riojæ* it differs principally in the slightly protruding mandible, reversed width of the internasal areas, the slightly longer adipose fin, and the coloration.

(Named for Prof. James Orton, who made collections in Peru many years ago.)

Rhamdia sapo (Valenciennes).

Rio Jacuhy and Sao Joao to Rio Negro and Chapada, Brazil.

Rhamdia brachyptera (Cope).

Pimelodus (Rhamdia) brachypterus Cope, Trans. Amer. Philos. Soc., (3) XIII, 1866, p. 404. Orizaba, Mexico.

No. 16,471, A. N. S. P., type of *P. (R.) brachypterus* Cope. F. Sumichrast. Orizaba, Mexico. Regan says,[4] "the original description of *P. brachypterus* Cope, from Orizaba, is insufficient, but Fowler's redescription of the type shows that this species is probably not distinct from *P. guatemalensis.*" However, according to Regan's key, it cannot fall with any of the species he includes under his first division with *R. guatemalensis*. It is likely somewhat near *R. managuensis*, though the occipital process extends only one-fourth the space from its base to the dorsal origin, and the interorbital width is 2½ in the head.

Rhamdella bathyurus (Cope).

Pimelodus bathyurus Cope, Proc. Amer. Philos. Soc., XVII, 1878, p. 674. Peruvian Amazon.

Nos. 21,437 and 38, A. N. S. P., cotypes of *P. bathyurus* Cope. Peruvian Amazon. J. Orton. Presented by E. D. Cope. This species differs from *Rhamdella parryi* and *R. minuta* in coloration.

Rhamdella nicaraguensis (Günther).

One from Nicaragua (J. F. Bransford). Regan figures this species,[5] but the barbels are shown as not quite reaching opposite dorsal origin. He says they extend to the origin of the adipose fin, according to Günther, and that "both barbels are now broken off in the type, the longest reaching the middle of the dorsal." My example shows the maxillary barbels reaching a little beyond ends of depressed ventrals.

Rhamdella straminea Cope.

Rhamdella straminea Cope, Proc. Amer. Philos. Soc., XXXIII, 1894, p. 93, Pl. 8, fig. 10. Rio Jacuhy, Brazil.

Nos. 21,581 to 84, and 21,604, A. N. S. P., cotypes. Rio Jacuhy, Brazil. H. H. Smith. Presented by E. D. Cope. No. 23,216, without data, is also identical (likely with the same data?).

[4] Biol. Cent. Am. Pisc., 1906–8, p. 128.
[5] *L.c.*, p. 131, Pl. 20, fig. 2.

Pimelodus maculatus Lacépède.

Pseudorhamdia piscatrix Cope, Proc. Amer. Philos. Soc., XI, 1870, p. 569. Pebas, Ecuador.

No. 8,387, A. N. S. P., type of *P. piscatrix* Cope. Pebas, Ecuador. J. Hauxwell.

Also examples from Demarara, Surinam, Ambyiacu River, and between the mouth of the Rio Negro and the Peruvian Amazon.

Pimelodus valenciennis Lütken.

Rio Jacuhy, Brazil.

Pimelodella cristata (Müller and Troschel).

Pimelodus ophthalmicus Cope, Proc. Amer. Philos. Soc., XVII, 1878, p. 675. Peruvian Amazon.

No. 21,102, A. N. S. P., cotypes of *P. ophthalmicus* Cope. Peruvian Amazon. J. Orton. 1873. Presented by E. D. Cope.

Pimelodella peruense sp. nov. Fig. 4.

Head $4\frac{1}{4}$; depth $4\frac{2}{3}$; D. I, 6; A. v, 9; P. I, 11; V. I, 6; head width $1\frac{1}{3}$ in its length; head depth at occiput $1\frac{1}{2}$; snout 3; eye $3\frac{1}{2}$; maxillary about 4; interorbital $3\frac{1}{5}$; dorsal spine 2; second branched dorsal ray $1\frac{1}{4}$; least depth of caudal peduncle $2\frac{1}{3}$; pectoral fin $1\frac{1}{3}$: ventral $1\frac{4}{5}$.

Body compressed, moderately elongate, somewhat slender, deepest at dorsal origin, and edges all convex. Caudal peduncle well compressed, and length about $\frac{3}{4}$ its least depth.

Head about wide as deep at occiput, sides convexly approximated above and broad or somewhat flattened below. Snout convex over surface, length about half its greatest width. Eye large, near upper profile, and about midway in head length. Eyelids little free, not adipose-like. Mouth broad, transverse, and upper jaw

and latter nearly $\frac{2}{3}$ of eye. No pseudobranchiæ. Branchiostegals 5, slender.

Body covered with smooth skin. Head smooth. Spines all more or less smooth. L. l. slopes down from shoulder, till midway along side, simple. Axillary pore moderate.

Dorsal origin about midway between front eye edge and anal origin, spine slender, nearly straight, edges apparently entire. Anal inserted slightly nearer caudal base than pectoral origin, first branched ray (damaged) apparently longest. Adipose fin moderate, $2\frac{1}{3}$ in combined head and trunk length. Caudal damaged. Pectoral moderate, reaches $\frac{2}{3}$ to ventral, spine smooth on outer edge and inner with about nine large serræ, of which longest at least little

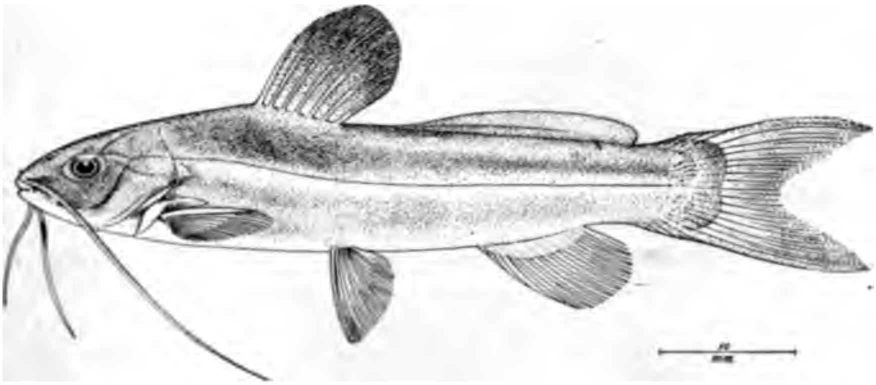

Fig. 4.—*Pimelodella peruense* Fowler. (Type.)

more than half greatest width of spine. Ventral inserted slightly nearer snout tip than caudal base, or below last dorsal rays, and fin extends $\frac{2}{3}$ to anal origin. Vent at first $\frac{2}{3}$ in depressed ventral length. Genital aperture well posterior, or slightly before depressed ventral tip, and papilla long and conic.

Color in alcohol largely brownish, under a lens seen to be made up of very close-set small dots. Lower surface of head, belly and sides paler, and on last extending up to lateral line. Fins all pale brownish, outer portion of dorsal dusky. Iris slaty. Maxillary barbels brownish and mental barbels whitish.

Length 52 mm. (caudal tips damaged).

Type, No. 21,932, A. N. S. P. Peruvian Amazon. Received many years ago from J. Orton or J. Hauxwell. Presented by E. D. Cope.

This species closely resembles *Pimelodella lateristriga* (Müller and

Troschel), though it differs in having the occipital process reaching the dorsal plate, maxillary barbel extending to tip of ventral fin, base of adipose fin 3 to 4 in length, ventral scarcely extending more than half way to anal and inserted little behind vertical from last dorsal ray, depth $6\frac{1}{2}$ to 7, and A. 12.[6] My example shows no trace of a dark lateral band, this region being entirely paler.

(Named for Peru.)

Pimelodella copei sp. nov. Fig. 5.

Pimelodus lateristriga (non Müller and Troschel) Cope, Proc. Acad. Nat. Sci. Phila., 1871 (1872), p. 270. Ambyiacu River.

Head $4\frac{7}{8}$; depth 5; D. I, 6; A. IV, 8, I; P. I, 8; V. I, 5; head width $1\frac{2}{5}$ in its length; head depth at occiput $1\frac{4}{7}$; snout $2\frac{1}{3}$; eye $4\frac{1}{8}$; maxillary $4\frac{2}{3}$; mouth width $2\frac{7}{8}$; interorbital 4; dorsal spine $1\frac{1}{4}$;

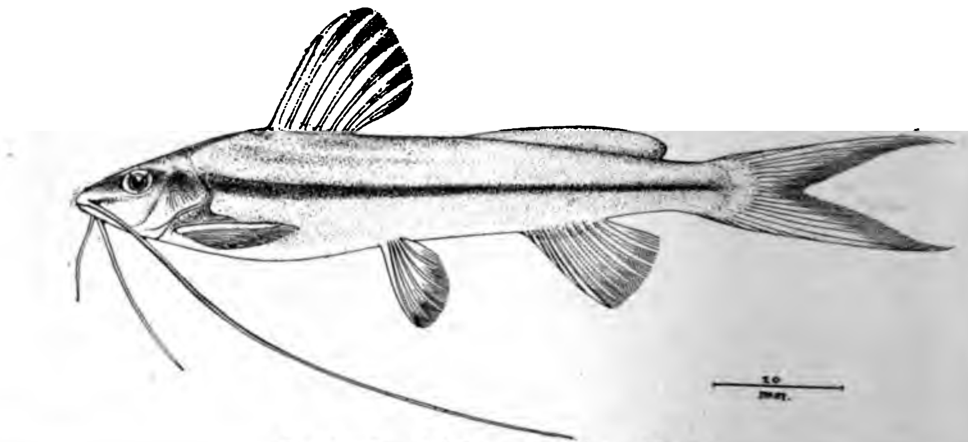

Fig. 5.—*Pimelodella copei* Fowler. (Type.)

wide contiguous bands in jaws. No vomerine or palatine teeth. Tongue broad, depressed, smooth, little free around front edges. Maxillary barbels long, extend back till midway in length of hind anal ray. Outer mental barbel extends back ⅞ in pectoral spine, inner reaches origin of pectoral. Rictal fissure deep, extending back from below hind end of maxillary to below narrow preorbital. Nostrils well separated, anterior in short tubes, and posterior simple pores. Interorbital depressed and flattened. Occipital process extends to dorsal plate, its length 1⅖ to dorsal origin, and of even width most its length. Occipital fontanel slender, long, slightly constricted within interorbital, and reaches occipital process. Opercle broad, with rather numerous radiating striæ.

Gill-opening extends forward about last fourth in snout length. Gill-rakers 2+6, lanceolate, firm, about ⅘ of filaments, and latter slightly more than half of eye. No pseudobranchiæ. Branchiostegals 6, outer rather large.

Skin smooth. Spines smooth. Humeral process striate, its length slightly more than half of pectoral spine. Dorsal and pectoral spines mostly with smooth surfaces. L. l. continuous, simple, little elevated at first, midway along side. Axillary pore moderate.

Dorsal origin about midway between snout tip and depressed ventral tip, spine slender, slightly curved, front edge with 11 antrorse serræ along its terminal half, hind edge entire, and depressed fin not quite extending back to origin of adipose fin. Anal origin nearer ventral origin than caudal base by snout length, and first branched ray longest. Adipose fin moderate, its length 3⅕ in combined head and trunk length. Caudal well forked, lobes long, slender and pointed, about equal apparently (damaged) and caudal fin about equals space between snout tip and dorsal origin. Pectoral extends ⅗ to ventral, spine about ⅞ length of fin, slightly curved, outer edge very finely roughened basally and terminal half with about ten antrorse serræ. Inner edge of pectoral spine slightly roughened medianly. Ventral origin slightly behind last dorsal ray base, and fin extends ⅗ to anal origin. Vent and genital aperture rather near, former about first third in depressed ventral and latter about last ⅗.

Color in alcohol pale brownish, lower surface of head and belly paler or somewhat whitish. A rather narrow darker brownish streak extends along side of snout to eye, and continued from hind edge of latter runs along upper side of abdomen to l. l., which it embraces below hind rays of dorsal, and then continues to caudal

base. Fins all pale brownish. Iris brownish. Maxillary barbels brownish, and others whitish.

Length 160 mm.

Type, No. 8,362, A. N. S. P. Ambyiacu River, near Pebas, Ecuador. John Hauxwell.

Paratype, No. 8,363, A. N. S. P., same data. Head $4\frac{4}{5}$; depth $5\frac{3}{4}$; D. I, 5; A. IV, 8, I; snout $2\frac{2}{5}$ in head; eye 4; maxillary $4\frac{1}{3}$; interorbital $3\frac{3}{4}$; dorsal spine $1\frac{1}{3}$; pectoral spine $1\frac{1}{4}$; length 152 mm.

This species was originally identified with *Pimelodus lateristrigus* Müller and Troschel by Cope, though at the time he pointed out that it differed somewhat "in the longer beards and one soft ray less in dorsal and anal fin." Eigenmann and Eigenmann state[7] that the maxillary barbels reach the ventral tips and the origin of the adipose dorsal, the gill-rakers 3+8, depth $6\frac{1}{3}$ to 7, and pectoral spine with unusually strong and sharp retrose hooks along the inner edge.

(Named for Prof. Edward D. Cope, who first pointed out its characters.)

Pimelodella cyanostigma (Cope).

Rhamdia cyanostigma Cope, Proc. Amer. Philos. Soc., XI, 1870, p. 569. Pebas, Ecuador.

Nos. 8,381 to 83, A. N. S. P., cotypes of *R. cyanostigma* Cope. Pebas, Ecuador. J. Hauxwell. Eigenmann and Eigenmann state,[8] "we are unable to tell to which genus this species belongs. Dr. Cope says that this species is allied to *Pimelodus ophthalmicus* = *Pimelodella cristatus*. But *cristatus* is generically different from *Rhamdia*, and was generally considered so when the statement was made." However, it is evident that Cope was correct in placing *cyanostigma* in *Pimelodus*, as *Pimelodella* (= *Pseudorhamdia* Steindachner) was

Pseudoplatystoma tigrinum (Valenciennes).

Large dried skin, without data.

Sorubim lima (Schneider).

Peru, Ambyiacu River in Ecuador, and Hyavary in Brazil.

SILURINÆ.

Silurus glanis Linnæus.

One from southern Europe.

Eutropius depressirostris (Peters).

Three from the Shebeli River in East Africa.

Eutropius seraoi Boulenger.

Ann. Mag. Nat. Hist. London, (8) VI, 1910, p. 556. Angola, West Africa.

No. 37,956, A. N. S. P., paratype, from the Luculla River, 365 kilometers from Lounda. Dr. J. V. Ansorge.

Schilbe mystus (Linnæus).

Nile? (Bonaparte Collection No. 368).

Physailia villiersi Boulenger.

Ann. Mus. Congo, (1) II, 1912, p. 17, Pl. 17, fig. 6. Angola, West Africa.

Nos. 38,756 to 58, A. N. S. P., paratypes. Luculla River in Chiloango. Dr. Ansorge.

Ansorgia vittata Boulenger.

L.c., Pl. 19, fig. 2. Angola, West Africa.

Nos. 38,734 and 35, A. N. S. P., paratypes. N'Kutu, Loango River. Dr. Ansorge.

Pterocryptis gangeticus Peters.

Two examples in very poor condition, obtained in the Ganges River, India, many years ago by Dr. M. Burrough.

PORCINÆ.

Porcus bajad (Forskål).

Nile.

Chrysichthys acutirostris Günther.

Bango River in Cabira, Angola (Dr. Ansorge).

Chrysichthys walkeri (Günther).

Chiloango River at Chiloango, Angola (Dr. Ansorge).

Chrysichthys ansorgii Boulenger.

Ann. Mag. Nat. Hist. London, (8) VI, 1910, p. 558. Angola, West Africa.

No. 37,906, A. N. S. P., paratype. Manzo River at Dondo. Dr. Ansorge.

Hemibagrus tengara (Hamilton-Buchanan).

Five from the Ganges River, India. Day's figure of an Assam example is not in agreement with his description, as the adipose fin is shown to begin close behind the base of the last dorsal ray, and the length of the fin would be contained in the combined head and trunk $3\frac{1}{4}$ times.[9]

Hypselobagrus cavasius (Hamilton-Buchanan).

Head $4\frac{2}{5}$; depth about 5; snout $2\frac{2}{3}$ in head; eye 3; interorbital $3\frac{1}{4}$. Upper jaw slightly protrudes. Outer mental barbel slightly longer than head. Occipital fontanel reaches base of occipital process. Dorsal spine entire on outer edge, several slight weak barbs on terminal hind edge. Adipose-fin length $2\frac{2}{3}$ in combined head and trunk length. Length 110 mm. (caudal damaged). Ganges River, India.

Hypselobagrus micracanthus (Bleeker).

Two from Padang, Sumatra.

Hypselobagrus nigriceps (Valenciennes).

Borneo.

Bagroides melapterus Bleeker.

Borneo.

Glyptothorax platypogon (Valenciennes).

Batu Sangkhar in Tanah Datar, Sumatra.

Glyptothorax platypogonoides (Bleeker).

Batu Sangkhar.

DORADINÆ.

Physopyxis lyra Cope.

Proc. Acad. Nat. Sci. Phila., 1871, p. 273, Pl. 5, figs. 1–c. Ambyiacu River,

scutes, whereas in the smaller example and the dried skin the first three spinescent lateral scutes are embraced. The Rupununi specimens also show the humeral plate extending a little further back.

Doras brachiatus Cope.

Proc. Acad. Nat. Sci. Phila., 1871 (1872), pp. 270, 292. Maranon River.

No. 8,342, A. N. S. P., type. Between the mouth of the Rio Negro and the Peruvian Amazon. R. Perkins.

Doras cataphractus (Linnæus).

Surinam.

Doras weddelli Castelnau.

Doras gryphus Cope, *l.c.*, p. 270, Pl. 15, figs. 1–1*a*. Ambyiacu River, Ecuador.

Nos. 8,345 and 16,460, A. N. S. P., cotypes of *D. gryphus* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

Doras pectinifrons Cope.

Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 568. Pebas, Ecuador.

No. 8,346, A. N. S. P., type. Pebas, Ecuador. J. Hauxwell.

Doras monitor (Cope).

Zathorax monitor Cope, Proc. Acad. Nat. Sci. Phila., 1871 (1872), p. 272, Pl. 4, fig. 1. Ambyiacu River, Ecuador.

Nos. 8,276 and 77, A. N. S. P., cotypes of *Z. monitor* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

Doras nauticus (Cope).

Zathorax nauticus Cope, Proc. Acad. Nat. Sci. Phila., 1874, p. 133. Nauta, Ecuador.

Nos. 21,390 to 95, A. N. S. P., cotypes of *Z. nauticus* Cope. Nauta, Ecuador. J. Orton.

Oxydoras niger (Valenciennes).

Rhinodoras prionomus Cope, Proc. Acad. Nat. Sci. Phila., 1874, p. 134. Nauta, Ecuador.

No. 21,203, A. N. S. P., type of *R. prionomus* Cope. Nauta, Ecuador. J. Orton.

Also two examples from the Maranon between mouth of Rio Negro and Peru.

AUCHENIPTERINÆ.

Centromochlus heckelii (Filippi).

One from Peruvian Amazon. Also six from Manaos harbor, Brazil, in April, 1913 (E. A. Smith), where known as "Caratay."

Trachycorystes isacanthus (Cope).

Auchenipterus isacanthus Cope, Proc. Amer. Philos. Soc., XVII, 1878, p. 677. Peruvian Amazon.

Nos. 21,444 and 45, A. N. S. P., cotypes of *A. isacanthus* Cope. Peruvian Amazon. J. Orton.

Trachycorystes galeatus (Linnæus).

Two examples from Surinam agree with my Rupununi River example in every respect. They also agree with Regan's figure of *Pseudauchenipterus guppyi* and his description of *Parauchenipterus paseæ*.[10]

Trachycorystes brevibarbus (Cope).

Auchenipterus brevibarbus Cope, Proc. Amer. Philos. Soc., XVII, 1878, p. 676. Peruvian Amazon.

No. 21,519, A. N. S. P., type of *A. brevibarbus* Cope. Peruvian Amazon. J. Orton. The ventrals are I, 5, not 7 as stated by Cope. Maxillary barbels not reaching middle of pectoral spine, but now only to about $\frac{1}{3}$ its length (tip broken). This species is close to *T. galeatus*, but differs in the broader predorsal plate, rougher casque and spines.

Pseudauchenipterus nodosus (Bloch).

Surinam.

Epapterus dispilurus Cope.

Proc. Amer. Philos. Soc., XVII, 1878, p. 677. Peruvian Amazon.

Nos. 21,353 and 54, A. N. S. P., cotypes. Peruvian Amazon. E. D. Cope.

Auchenipterus nuchalis (Agassiz).

Peruvian Amazon.

Auchenipterus ambyiacus sp. nov. Fig. 6.

Adipose eyelid covers eye completely. Mouth broad, crescentic as viewed below, and jaws about even. A band of sparse villiform teeth in jaws, narrow, continuous, though slightly expanded at each end. Sparse villiform teeth in mandible, areas becoming wider at symphysis, where separated by narrow naked median area. Roof of mouth without teeth. Inner buccal folds moderate. Tongue thick, depressed, smooth, little free. Barbels slender, maxillary reaching $\frac{2}{3}$ in pectoral spine. Mental barbels equally spaced, all extend back about opposite pectoral origin. Anterior internasal space slightly greater than posterior, nostrils all simple pores, anterior also very close to snout edge, and posterior little nearer eye than snout tip. Occipital fontanel broad, extends up till little beyond hind eye edge. Supraoccipital process extends to dorsal plate, though both covered with thin skin and smooth. Opercle wide, smooth.

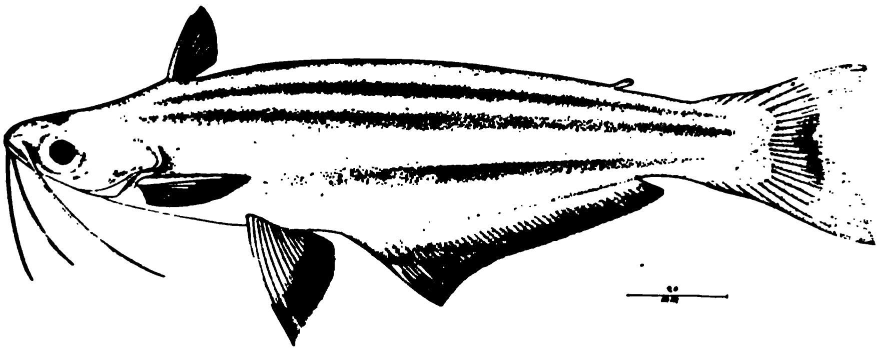

Fig. 6.—*Auchenipterus ambyiacus* Fowler. (Type.)

Gill-opening extends forward about first third in postorbital region of head. Gill-rakers about 10+23, slender, pointed, about $\frac{4}{5}$ length of filaments, and latter about $1\frac{1}{5}$ in eye. No pseudobranchiæ. Branchiostegals slender.

Skin smooth, no rugose areas. Shoulder-girdle at base of pectoral spine slightly swollen. Humeral process short, pointed, slender, covered with skin, and extends about first third in length of depressed pectoral spine. Axillary pore not evident. L. l. obsolete at present, apparently continuous along side indicated by vertebral centra.

Dorsal small, well anterior, inserted slightly nearer anal origin than snout tip, spine slender, nearly straight, front edge smooth and hind edge slightly serrated. Adipose fin small, inserted about last fourth in space between dorsal origin and caudal base, fin about

two in eye. Anal with long, straight base, anterior branched rays slightly longer, and base of fin $2\frac{2}{5}$ in combined length of head and trunk. Caudal (damaged) broad, and apparently forked. Pectoral with long and nearly straight spine, its surface with fine lengthwise striæ, its outer edge smooth and its inner edge serrated, when depressed extending nearly to ventral. Latter broad, first ray straight. Vent about midway in length of ventral.

Color in alcohol dull brownish generally, with grayish shade on back and upper portions. Lower portions of body slightly paler than upper. From shoulder towards middle of upper caudal lobe pale dusky-gray streak, and another below and parallel from ventral origin. Barbels brownish, also eyes. Fins all brownish.

Length 163 mm. (caudal tips damaged).

Type, No. 21,484, A. N. S. P., Ambyiacu River, Ecuador. J. Hauxwell. Presented by E. D. Cope.

This species is related to *Auchenipterus nuchalis*, but differs at once in its deeper body. *A. nuchalis* has the greatest body depth $4\frac{3}{4}$ to 5, and mental barbels extending a little beyond middle of pectorals.

(Named for the Ambyiacu River.)

Auchenipterus brachyurus (Cope).

Euanemus brachyurus Cope, Proc. Amer. Philos. Soc., XVII, 1878, p. 676. Peruvian Amazon.

No. 21,552, A. N. S. P., type of *E. brachyurus* Cope. Peruvian Amazon. J. Orton. Presented by E. D. Cope.

Ageneiosus porphyreus Cope.

Trans. Amer. Philos. Soc., (2) XIII, 1867, p. 404. Surinam.

No. 8,389, A. N. S. P., type. Surinam. Also a small example

states that the pectorals reach the first or fifth ventral ray. Though he also gives the anal rays 34, possibly this may include some of the rudimentary ones, as most writers mention 32 branched. My Peruvian example is damaged somewhat, though now measures 200 mm., has the A. IV, 32, and the pectorals (damaged) do not appear to reach the ventral. *A. ogilviei* is very close and, like *A. marmoratus*, may be found identical.

TORPEDININÆ.

Torpedo electricus (Gmelin).

Two from Liberia and one from the Lebuzi River at Kuka Muno, West Africa.

ASPREDINIDÆ.

Aspredo aspredo (Linnæus).

Brazil and Surinam.

Platystacus cotylephorus Bloch.

Surinam.

Dysichthys coracoideus Cope.

Proc. Acad. Nat. Sci. Phila., 1874, p. 133. Nauta.

Nos. 21,212 to 15, A. N. S. P., cotypes. Nauta, Ecuador. J. Orton. Presented by E. D. Cope.

Bunocephalus melas Cope.

L.c., p. 132. Nauta.

No. 21,235, A. N. S. P., type. Nauta, Ecuador. J. Orton. From Cope.

Bunocephalus aleuropsis Cope.

Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 568. Pebas, Ecuador.

Nos. 8,286 to 88, A. N. S. P., cotypes. Pebas, Ecuador. J. Hauxwell. From Cope.

PLOTOSIDÆ.

Plotosus anguillaris (Bloch).

Padang, Sumatra; Singapore, Malacca; Apia, Samoa; Bacon, Philippine Islands. The Padang examples are without whitish lengthwise streaks. All others smaller and show the whitish streaks clearly, even the very young.

CLARIIDÆ.

Clarias senegalensis (Valenciennes).

Senegal.

Clarias mossambicus Peters.

Shebeli River, East Africa. Günther says, "Two small specimens of *Clarias* collected on the Shebeli River are not in sufficiently good condition to be determined. The form of the vomerine band is very different from that of the fish described as *C. smithii.*" These examples show the hind edge of the vomerine band slightly double-convex, evidently an individual character, as they are in all other respects similar to the present species and to which they undoubtedly belong.

Clarias batrachus (Linnæus).

Padang and Batu Sangkar, Sumatra.

Clarias angolensis Steindachner.

West Africa, also the Luali River at Lundo.

Clarias duchaillui sp. nov. Fig. 7.

Head $4\frac{4}{7}$; depth at anal origin $6\frac{1}{4}$; D. 76; A. 57; P. I, 10; V. I, 5; head width $1\frac{1}{4}$ in its length; head depth at occiput $1\frac{3}{5}$; snout $2\frac{2}{3}$; eye 8; mouth width 2; interorbital $1\frac{7}{8}$; least depth of caudal peduncle $3\frac{1}{3}$; caudal $1\frac{2}{3}$; pectoral $1\frac{4}{7}$; ventral $2\frac{1}{4}$.

Body elongate, sides and trunk well compressed, deepest at dorsal origin, and profiles mostly similar. Caudal peduncle entirely free, well compressed.

Head broad, depressed, upper surface slightly more convex behind, and profiles similar. Snout broad, depressed, slightly protrudes beyond mandible, and length about half its greatest width. Eye small, rounded, superior, and placed near first $\frac{2}{5}$ in head length. Eyelids free. Mouth wide, with very short commissure. Teeth

occipital process, moderate. Occipital process triangular, extends about first fourth in predorsal space.

Gill-openings large, extend forward about first $\frac{2}{3}$ in head. Gill-rakers 1+9, lanceolate, about equal filaments or eye in length. Shoulder-girdle, within gill-opening, with a well-developed process opposite origin of pectoral spine. Branchiostegals moderate.

Body covered with smooth skin. L. l. simple, slopes from shoulder till midway along side of trunk, though not continued beyond caudal peduncle.

Dorsal inserted slightly behind first third in combined head and trunk length, free from caudal behind. Anal origin nearer caudal base than snout tip, also free from caudal behind. Caudal elongate, rounded behind. Pectoral $1\frac{2}{3}$ to ventral, spine with rough serræ

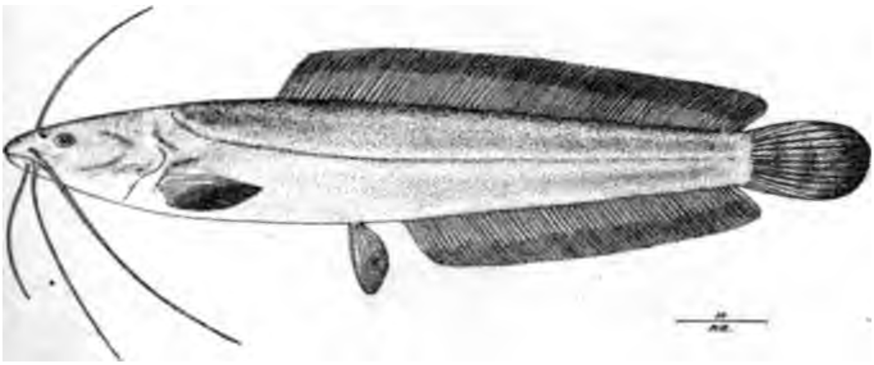

Fig. 7.—*Clarias duchaillui* Fowler. (Type.)

along both edges, anterior retrorse, and posterior only on terminal portion of edge. Ventral small, inserted well back, and reaches slightly beyond anal origin. Vent close before anal.

Color in alcohol uniform dull brownish, fins and lower surface of head all paler. Iris dull slaty. Barbels brownish.

Length 97 mm.

Type, No. 8,568, A. N. S. P. Gaboon Country, West Africa. P. B. Du Chaillu.

Also Nos. 8,569 to 8,574, A. N. S. P., paratypes, same data. These show: Head $4\frac{2}{3}$ to $4\frac{3}{4}$; depth $6\frac{1}{3}$ to $6\frac{2}{3}$; D. 70 to 78; A. 56 to 62; snout $2\frac{1}{3}$ to $2\frac{2}{3}$ in head; eye 7 to 8; mouth width 2 to $2\frac{1}{8}$; interorbital $1\frac{2}{3}$ to $1\frac{7}{8}$; length 76 to 92 mm.

This species is apparently allied with *Clarias submarginatus*

Peters,[13] from Cameroon, agreeing in the few gill-rakers, concealed clavicles, dorsal rays, and width of the head. It differs, however, in the much longer barbels, fewer anal rays, longer pectoral and caudal fins, and in the caudal showing traces of about three somewhat irregular darker transverse bars.

(Named for Paul B. Du Chaillu, who many years ago collected fishes in the Gaboon Country.)

Phagorus nieuhofii (Valenciennes).

One from Borneo.

Channallabes apus (Günther).

Two from Lubuzi River at Kuka Muno in Chiloango, West Africa.

Saccobranchus fossilis (Bloch).

Ganges River, India.

HOLOGENEIDÆ.

Hologenes marmoratus (Günther).

Holmia, British Guiana.

HYPOPHTHALMIDÆ.

Hypophthalmus edentatus (Agassiz).

Peruvian Amazon.

PYGIDIIDÆ.

CETOPSINÆ.

Hemicetopsis candiru (Agassiz).

Peruvian Amazon.

Cetopsis coecutiens (Lichtenstein).

Ambyiacu River, and Amazon between mouth of Rio Negro and

Pygidium poeyanum (Cope).

Trichomycterus poeyanus Cope, Proc. Amer. Philos. Soc., XVII, 1877, p. 47 (on *T. rivulatus* Cope).
Trichomycterus rivulatus (non Valenciennes) Cope, Proc. Acad. Nat. Sci. Phila., 1874, p. 132. Arequipa, Peru.

Nos. 21,382 and 83, A. N. S. P., cotypes of *T. poeyanus* Cope. Arequipa, Peru. J. Orton. This species is close to *P. rivulatum*, differing in its large, dark blotches.

Pygidium dispar Tschudi.

One example, which Cope refers to as "a large specimen of the *T. pardus*, which, according to the label, came from Callao Bay." At present, however, it is labelled as having been secured at Tinta.

Pareiodon microps Kner.

Amazon between mouth of Rio Negro to Peru.

CALLICHTHYIDÆ.

Callichthys callichthys (Linnæus).

Surinam, Nauta, Pebas, Ambyiacu River and Rio Jacuhy. This large series shows considerable variation. Adults and young have variably long or short pectoral spines, which may reach the ventral or only half as far. Plates on caudal base in two clusters, which may vary 3 or 4, though usually 4 in each.

Hoplosternum littorale (Hancock).

Trinidad and Venezuela.

Hoplosternum thoracatum (Valenciennes).

Nauta, Ecuador.

Hoplosternum oronocoi sp. nov. Fig. 8.

Hoplosternum thoracatum (non Valenciennes) Fowler, Proc. Acad. Nat. Sci. Phila., 1911, p. 436. La Pedrita, Venezuela.

Head $3\frac{3}{5}$; depth $3\frac{1}{5}$; D. I, 7; A. I, 5; P. I, 8; V. I, 5; lateral plates 25 above, 23 below, to caudal base; snout $2\frac{1}{10}$ in head; eye 7; mouth width $3\frac{1}{2}$; interorbital $1\frac{3}{5}$; dorsal spine 2; adipose spine $3\frac{1}{2}$; pectoral spine $1\frac{2}{5}$; anal spine $2\frac{1}{5}$; least depth of caudal peduncle $1\frac{2}{5}$; caudal 1; ventral $1\frac{3}{5}$.

Body moderately long, well compressed, deepest at dorsal origin, and edges all convex. Caudal peduncle greatly compressed, as measured to last anal ray, base about half as long as deep.

Head moderate, depressed, upper profile little more inclined, surfaces all convex. Snout broad, depressed, and length about $\frac{3}{5}$ its greatest width. Eye small, rounded, laterally superior, hind edge about midway in length of head. Mouth moderate, upper jaw very slightly protruding. Teeth minute, in broad bands in

each jaw, though upper of shorter extent. Inner buccal folds both wide. Lower lip wide, with slight notch at symphysis. Outer barbel reaches about first sixth in pectoral spine, and inner barbel extends very slightly beyond tip of pectoral fin. Anterior nostril in short tube about midway in snout length, and posterior simple pore close behind and a little superior. Interorbital broadly convex. Fontanel within interorbital, and its length about equals eye.

Gill-opening extends forward to last third in head. Gill-rakers 1+8 short and rather blunt firm points, about $\frac{3}{4}$ length of filaments, and latter equal eye. Isthmus wide.

Bony plates on trunk each with minute denticulations along hind edges, also on spines of fins completely over their outer or lateral surfaces and humeral process. Plates on head and predorsal

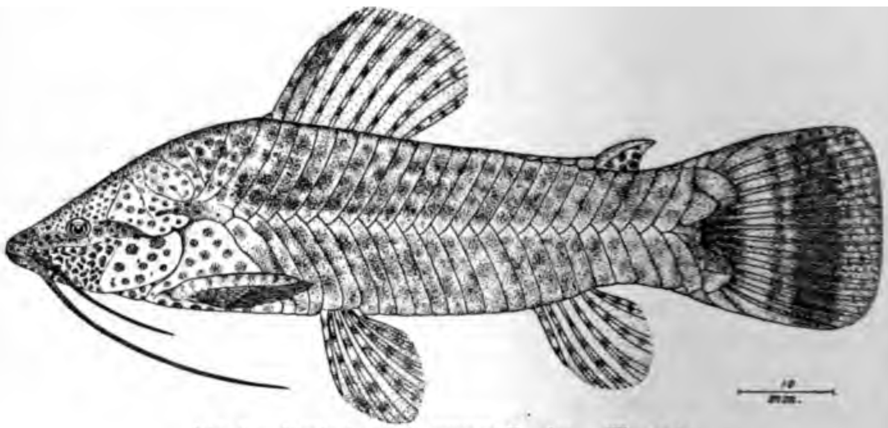

Fig. 8.—*Hoplosternum oronocoi* Fowler. (Type.)

shorter than longest ray. Pectoral with strong, curved spine, reaches ventral. Latter inserted little nearer snout tip than caudal base, fin extending ⅔ to anal. Vent well anterior, or close behind ventral bases.

Color in alcohol largely dark brownish, trunk more or less mottled with paler areas or blotches, and smaller dusky spots of irregular and often obscure definition on scutes. On head, breast and belly many close-set, small blackish spots, though becoming larger and fewer on belly. All fins with obscure dusky spots, though on caudal mostly united to form median broad blackish transverse band, in extent nearly half length of fin. Hind edge of caudal also dusky. Iris slaty. Barbels dusky.

Length 102 mm.

Type, No. 37,895, A. N. S. P. La Pedrita, Cano Uracoa, Venezuela. February 16, 1911. F. E. Bond and Stewardson Brown.

Only the above example. It is related to *Callichthys pectoralis* Boulenger,[14] which has been identified by Eigenmann with *C. melampterus* Cope, a species certainly distinct. *C. pectoralis* is evidently a *Hoplosternum*, however, and differs from the present species in its depth 3¼ to 3½, large eye (though this may be due to age), inner barbels half total length, and lateral plates 23 above and 22 below, while in other respects it agrees. No description of the caudal coloration or other details have been given for *C. pectoralis*, so that its identity is uncertain. *H. schreineri* Ribeiro I have been unable to consult.

(Named for the Oronoco River, in the delta country of which the type was secured.)

CATAPHRACTOPS subgen. nov.

Type *Callichthys melampterus* Cope.

Lower jaw without barbels, though two at each rictus. Coracoid but slightly exposed below, and ventral surface largely naked. Dorsal spine low and flat. Pectoral spine finely serrated on inner edge, outer bristly. Supraoccipital plate truncate behind, so that narrow median naked predorsal strip extends before dorsal plate.

Differs from subgenus *Hoplosternum* in the naked predorsal region and truncate hind edge of supraoccipital process, together with the slightly exposed coracoid processes.

(*Cataphractus*, an old generic name for the plated nematognaths; ὤψ, appearance.)

[14] Proc. Zool. Soc. London, 1895, p. 525. Monte Sociedad, Paraguayan Chaco.

Hoplosternum melampterum (Cope).

Callichthys melampterus Cope, Proc. Acad. Nat. Sci. Phila., 1871, p. 275. Ambyiacu River.

Nos. 8,318 to 28, A. N. S. P., cotypes of *C. melampterus* Cope. Ambyiacu River, Ecuador. J. Hauxwell. Also two examples without definite locality, from Cope.

Dianema longibarbis Cope.

L.c., p. 276, Pl. 7, figs. 1–1*b*. Ambyiacu River.

Nos. 21,540 and 8,285, A. N. S. P., cotypes. Ambyiacu River, Ecuador. J. Hauxwell.

Chænothorax semiscutatus (Cope).

Corydorus semiscutatus Cope, *l.c.*, p. 280, Pl. 6, fig. 1. Ambyiacu River.

No. 8,289, A. N. S. P., type of *C. semiscutatus* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

Chænothorax bicarinatus Cope.

Proc. Amer. Philos. Soc., XVII, 1878, p. 679. Peruvian Amazon.

No. 21,447, A. N. S. P., type. Peruvian Amazon. J. Orton.

Brochis cœruleus Cope.

Proc. Acad. Nat. Sci. Phila., 1871, p. 277, Pl. 7, fig. 2, Pl. 9, fig. 3. Ambyiacu River.

Nos. 8,231 to 37, A. N. S. P., cotypes. Ambyiacu River, Ecuador. J. Hauxwell.

Corydorus acutus Cope.

L.c., p. 281. Ambyiacu River.

Nos. 8,292 and 93, A. N. S. P., cotypes. Ambyiacu River, Ecuador. J. Hauxwell. These examples in very poor condition. Possibly they may be found identical with *C. punctatus* (Bloch).

Corydorus ambiacus Cope.

L.c., p. 280. Ambyiacu River.

Corydorus paleatus (Jenyns).

Many from the Rio Jacuhy, Brazil.

LORICARIIDÆ.

PLECOSTOMINÆ.

Plecostomus plecostomus (Linnæus).

One from Surinam (Hering). A large example (418 mm. long without caudal), no data, is evidently identical.

Plecostomus commersonnii (Valenciennes).

Rio Jacuhy.

Plecostomus aspilogaster Cope.

Proc. Amer. Philos. Soc. Phila., XXXIII, 1894, p. 100, Pl. 8, fig. 14. Rio Jacuhy, Brazil.

Nos. 21,781 to 84, A. N. S. P., cotypes. Rio Jacuhy, Brazil. H. H. Smith. This is evidently a distinct species, and not at all to be confused with *P. commersonnii*, as questioned by Regan.[15] It would clearly fall with the species *P. verres*, *P. carinatus* and *P. vaillanti*, according to Regan's key, where the character shared in common is "supraoccipital bordered posteriorly by a median scute, and by one or more on each side." It differs from all three of these species in having the l. l. 30, and the lateral keels weak.

Plecostomus emarginatus (Valenciennes).

Plecostomus scopularius Cope, Proc. Acad. Nat. Sci. Phila., 1871, p. 55. Amazon above mouth of Rio Negro.
Plecostomus biseriatus Cope, *l.c.*, p. 285, Pl. 16. Amazon.
Plecostomus virescens Cope, *l.c.*, 1874, p. 137. Upper Amazon.

No. 8,081, A. N. S. P., type of *P. scopularius* Cope. Amazon above mouth of Rio Negro. R. Perkins.

No. 8,279, A. N. S. P., type of *P. biseriatus* Cope. Amazon. R. Perkins.

Nos. 21,280 to 83, A. N. S. P., cotypes of *P. virescens* Cope. Peruvian Amazon. J. Orton.

Also small example from Peru obtained by Orton.

Pterygoplichthys multiradiatus (Hancock).

Liposarcus varius Cope, Proc. Acad. Nat. Sci. Phila., 1871, p. 284. Ambyiacu River.
Liposarcus jeanesianus Cope, *l.c.*, 1874, p. 135. Nauta.

No. 21,931, A. N. S. P., type of *L. varius* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

Nos. 21,925 and 26, A. N. S. P., paratypes. Amazon from mouth of Rio Negro to Peru. R. Perkins.

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[15] Trans. Zool. Soc. London, XVII, pt. 3, 1904, p. 206.

Nos. 8,241 and 42, A. N. S. P., cotypes of *L. jeanesianus* Cope. Nauta. J. Orton.

Also other examples from the above localities.

Chætostomus sericeus Cope.

L.c., 1871, p. 288. Ambyiacu River.

No. 22,005, A. N. S. P., type. Ambyiacu River, Ecuador. J. Hauxwell. It is not a species of *Xenocara*, as suggested with question by Regan,[16] though closely related to his *C. maculatus*.[17]

Ancistrus dolichopteryx Kner.

Two from Pebas, Peru, received from Cope. They agree with Kner's account and figure, though are a little larger. They are also rougher and the spines more or less spinescent. The fins are spotted with blackish.

Ancistrus alga (Cope).

Chætostomus alga Cope, Proc. Acad. Nat. Sci. Phila., 1871, p. 287, Pl. 15, fig. Ambyiacu River.
Chætostomus malacops Cope, *l.c.* Ambyiacu River.
Chætostomus tectirostris Cope, *l.c.*, p. 288. Ambyiacu River.

Nos. 16,461 and 62, A. N. S. P., cotypes of *C. alga* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

No. 8,299, A. N. S. P., cotype of *C. malacops* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

Nos. 8,298 and 8,300, A. N. S. P., cotypes of *C. tectirostris* Cope. Ambyiacu River, Ecuador. J. Hauxwell.

This species is allowed distinct and closely related to *A. hoplogenys* (Günther), which is described as having but 8 or 9 interopercular spines. I have two examples, of nearly similar size, of *A. hoplogenys* from the Rupununi which agree in this character. Further, they are also white-dotted. The types of *C. alga* show the interopercular

Lithoxus lithoides Eigenmann.

Mem. Carnegie Mus., V, 1912, p. 242, Pl. 29, figs. 1–4. (Warraputa) British Guiana.

No. 39,121, A. N. S. P., paratype. Warraputa, British Guiana. In exchange with Carnegie Museum.

HYPOPTOPOMINÆ.

Hypoptopoma thoracatum Günther.

Hypoptopoma bilobatum Cope, Proc. Amer. Philos. Soc. Phila., XI, 1870, p. 566, 2 figs. Pebas, Ecuador.

Nos. 8,280 and 81, A. N. S. P., cotypes of *H. bilobatum* Cope. Pebas, Ecuador. J. Hauxwell. These agree with *H. thoracatum* in their ventral armature. In the smaller example the median series of scutes do not approximate those on each side.

Also an example from the Peruvian Amazon.

Hypoptopoma psilogaster sp. nov. Fig. 9.

Hypoptopoma bilobatum (part) Cope, Proc. Amer. Philos. Soc. Phila., XVII 1878, p. 679. Peruvian Amazon.

Head 4; depth 6$\frac{2}{3}$; D. I, 7; A. I, 5; P. I, 6; V. I, 5; 26 plates in lateral series, of which last on caudal base; 3 predorsal plates; head width 1$\frac{2}{7}$ in its length; head depth at occiput 2; snout 1$\frac{2}{3}$; eye 4$\frac{2}{3}$; mouth width 3$\frac{1}{2}$; interorbital 1$\frac{2}{3}$; least depth of caudal peduncle 3$\frac{2}{3}$; pectoral spine 1$\frac{1}{3}$.

Body long, slender in lateral profile, depressed as viewed from above, deepest at dorsal origin, and edges all smoothly convex. Caudal peduncle rather robust, becoming compressed behind, and its least depth about $\frac{1}{3}$ its length measured to rudimentary adipose fin-spine.

Head short, well depressed, and profiles similar. Snout broad, depressed, its length $\frac{3}{4}$ its basal width. Eye moderate, lateral, and its center about last fourth in head. Eyelids free. Mouth rather broad, transverse, and placed about first $\frac{2}{3}$ in snout. Disk rounded, apparently with entire edges, and surface with a few papillæ on lower lip. Teeth slender, simple, uniserial, long, and slightly bent, compressed tips blunt. Inner buccal folds apparently broad. Tongue broad, fleshy, little distinct at present. Each lateral corner of buccal disk with short triangular fleshy barbel, apparently less than half of eye in length. Nostrils together, simple pore within depression on top of head just before front edge of eye, extent of depression each less than half of eye, and bony internasal region trifle more than eye. Interorbital broadly and slightly convex. Occipital process broadly triangular. Opercle large and very porous.

Gill-openings small, inferiorly lateral, extend forward about opposite hind edge of eye. Isthmus moderately broad, width $1\frac{2}{3}$ in snout.

Body almost everywhere minutely spinose. Scales without distinct keels. Eight plates between dorsal and adipose fin. Snout all more or less roughened, especially along sides. Lower surface of head and abdomen entirely naked, only interrupted by striate osseous exposures of coracoids. Fin spines all spinulose. L. l. scarcely distinct.

Dorsal origin placed little nearer origin of adipose fin than snout tip, spine (damaged) slightly enlarged and evidently longest of fin

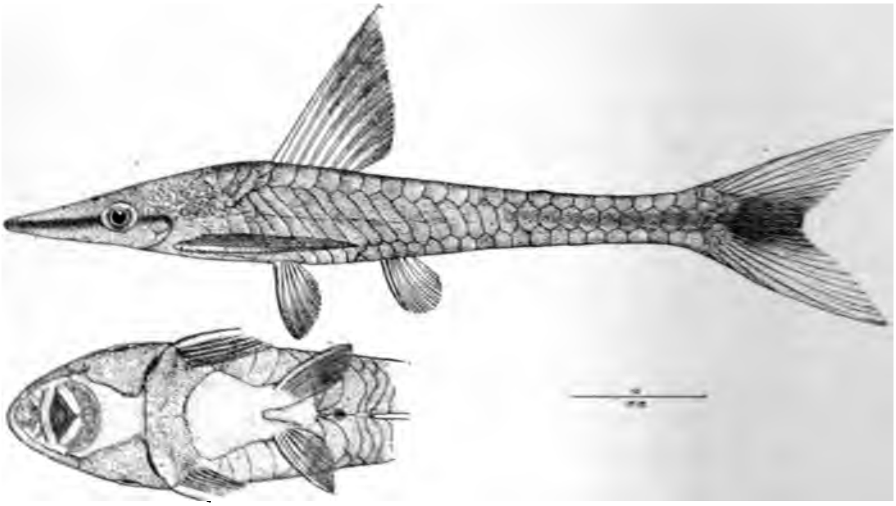

Fig. 9.—*Hypoptopoma psilogaster* Fowler. (Type.)

Length 56 mm. (caudal damaged).

Type, No. 21,922, A. N. S. P. Peruvian Amazon. 1873. J. Orton. Received from E. D. Cope.

The above example was formerly identified with the preceding species, but is here allowed distinct provisionally, for if simply a variant is quite anomalous. The type of *H. psilogaster* is larger than the smallest example of *H. thoracatum*, and it has but two rows of ventral scutes, the space between being naked.

(Ψιλός, naked; γαστήρ, stomach.)

DIAPELTOPLITES subgen. nov.

Type *Hypoptopoma gulare* Cope.

Differs from the subgenus *Hypoptopoma* Günther, as here understood, in the ventral armature consisting largely of two series of plates, though a single plate interposed between the first pair.

The species embraced in this subgenus are *H. gulare* Cope, *H. joberti* (Vaillant) and *H. steindachneri* Boulenger. The subgenus *Hypoptopoma* contains only *H. thoracatum* Günther and *H. psilogaster*, described previously.

(Δία, divided; πέλτη, shield; ὁπλίτης, armed; with reference to the double series of shields on the belly.)

Hypoptopoma gulare Cope.

Proc. Amer. Philos. Soc. Phila., XVII, 1878, p. 679. Peruvian Amazon.

No. 21,477, A. N. S. P., type. Peruvian Amazon. J. Orton.

Otocinclus vestitus Cope.

Proc. Acad. Nat. Sci. Phila., 1871, p. 83, Pl. 4, fig. 2. Tributary of Ambyiacu River.

Nos. 8,283 and 84, A. N. S. P., cotypes. Tributary of Ambyiacu River, Ecuador. J. Hauxwell.

Otocinclus flexilis Cope.

Proc. Amer. Philos. Soc. Phila., XXXIII, 1894, p. 97, Pl. 8, figs. 13*a*–*b*. Rio Jacuhy.

Otocinclus fimbriatus Cope, *l.c.*, p. 98, Pl. 9, figs. 16*a*–*b*. Rio Jacuhy.

Nos. 21,622 to 26, A. N. S. P., cotypes of *O. flexilis* Cope. Rio Jacuhy, Brazil. H. H. Smith.

Nos. 21,752 to 55, A. N. S. P., cotypes of *O. fimbriatus* Cope. Same data. This nominal form appears to be a condition of greater age.

Microlepidogaster nigricauda (Boulenger).

Rio Jacuhy, Brazil.

Microlepidogaster lævior (Cope).

Hisonotus lævior Cope, Proc. Amer. Philos. Soc. Phila., XXXIII, 1894, p. 95, Pl. 7, fig. 12. Rio Jacuhy.

No. 21,563, A. N. S. P., type of *H. lævior* Cope. Rio Jacuhy, Brazil. H. H. Smith. Both this and the following species have been merged with the preceding, though they appear to me distinct.

Microlepidogaster leptochilus (Cope).

Hisonotus leptochilus Cope, Proc. Amer. Philos. Soc. Phila., XXXIII, 1894, p. 96, Pl. 7, fig. 11. Rio Jacuhy.

No. 21,564, A. N. S. P., type of *H. leptochilus* Cope. Rio Jacuhy, Brazil. H. H. Smith.

LORICARIINÆ.

Rhineloricaria cadeæ Hensel.

Rio Jacuhy, Brazil.

Loricariichthys typus (Bleeker).

Two examples, 208 and 224 mm. (caudal tips slightly damaged), from Surinam. They agree with Bleeker's account[18] in having 14 caudal scutes, though Regan gives[19] but 10 or 11, which is in agreement with Steindachner's figure of *Loricaria stubelii.*[20] The interorbital space, in my specimens, is flat, with the eye nearly impinging on the upper profile of the head. In Bleeker's figure the interorbital space is shown as elevated. My examples agree with *L. stubelii* in their occipital armament, though ventrally they have at least four rows of plates. In *L. stubelii* the figure shows the median ventral plates absent in one case. Traces of dark spots are also evident on the fins.

Loricariichthys hauxwelli sp. nov. Fig. 10.

Loricaria acuta (non Valenciennes) Cope, Proc. Acad. Nat. Sci. Phila., 1871,

Head elongate, depressed, broadly convex above and more or less flattened below. Snout depressed, somewhat acuminate, length about equals greatest width, and upper profile slightly concave in front. Eye moderate, with eye socket well notched behind, general form ellipsoid, and center falls about last third in head length. Mouth anterior or slightly before middle in snout length, transverse, and jaws firm. Teeth apparently few, minute, close-set and uniserial. Buccal disk (damaged) apparently more or less rounded? Tongue broad, depressed, scarcely free. Nostrils together within an aperture about half length of orbital aperture, to which close before in lateral profile, and hind edge of aperture slopes up gradually.

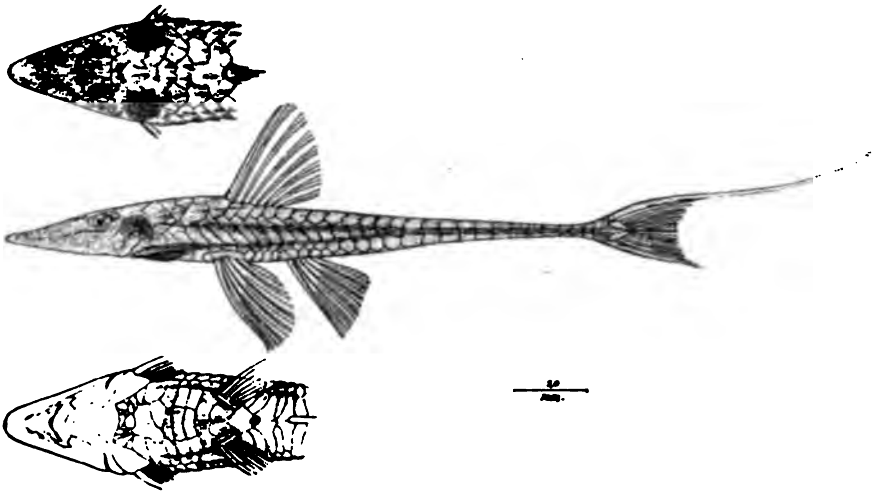

Fig. 10.—*Loricariichthys hauxwelli* Fowler. (Type.)

Internasal space slightly less than half of interorbital. Cheeks very slightly concave, and interorbital similar. Opercle large, porous. Supraoccipital process broad basally, though forms narrow point about $\frac{3}{5}$ basal width.

Gill-openings lateral, extend forward about opposite eye center. Gill-rakers 4+8 ? short firm points, much less than filaments and latter little less than eye. Branchiostegals with outer broad.

Scales, or scutes, all more or less minutely spinescent. Predorsal region with 3 scutes to occipital. Three series of scutes transversely across middle of belly, with inner series broad. Anteriorly, or on breast, scutes smaller or more numerous. Two scutes between ventrals. Anterior 2 predorsal scales each with strong keel on each

side, and scales on each side with keel, which becomes obliterated after second scale along dorsal base, and posteriorly till near middle in length of caudal peduncle it forms only slight convexity on each scale. Lateral keels on each side made up of minute serræ, straight in their arrangement, and graduated longer to last, which largest. Each lateral scale of belly with rather obsolete keel. Head all more or less roughened with minute asperities, though slightly more conspicuous along lower edge of snout. All fin spines and outer rays of caudal finely spinescent.

Dorsal origin falls behind first third in length about an eye-diameter, spine slender and not larger than longer rays. Anal inserted well behind dorsal base, or slightly nearer snout tip than caudal base, spine scarcely larger than rays, and depressed fin extends 2⅘ to caudal base. Caudal small, median rays short, and outer or upper and lower ones slightly enlarged. Pectoral reaches ventral, spine flexuous, longer than rays. Ventral inserted slightly before dorsal origin, spine long and flexuous, and reaches back about opposite middle of third scale along anal base. Vent about midway between ventral and anal origins.

Color in alcohol largely uniform brownish, apparently greatly faded. Lower surface of body pale. Fins all pale, uniform, and caudal with several pale irregular cross streaks. Iris dark.

Length 180 mm. (caudal tips damaged).

Type, No. 8,301, A. N. S. P. Ambyiacu River, Ecuador. John Hauxwell.

This example is close to *Loricariichthys maculatus* (Bloch), and may ultimately be found identical. Bloch's poor figure[21] does not show much detail fit for comparison, and the synonymous

Loricariichthys anus (Valenciennes).

Rio Jacuhy, Brazil. One of the smallest examples, 210 mm. long, differs in having the lateral scutes 25+9, which is more in accordance with the characters distinguishing *Loricaria spixii* Steindachner. In other respects it agrees with the present species.

Loricaria cataphracta Linnæus.

One from Surinam, 228 mm. long (caudal tips damaged). Head width 1⅓ in its length. Internasal region slightly elevated convexly. No lengthwise keels on interorbital and anterior occipital region. Ventral plates medianly in 3 or 4 irregular series. Lower naked surface of head extends rather well back on clavicle region.

Loricaria carinata Castelnau.

One from the Rio Maranon, 185 mm. long (caudal tips damaged). Head width 1¼ in its length. Internasal region not elevated. Two low lengthwise keels within interorbital space, approximating behind, where they continue closer as better marked supraoccipital keels. Ventral plates medianly in 4 or 5 irregular series. Naked surface of head below not extending on clavicles, which covered with many small plates. This specimen agrees with Eigenmann's photograph. The species is apparently not previously known from the Maranon, Cope having confused it with *L. cataphracta*.

Harttia platystoma (Günther).

Warraputa Falls, British Guiana.

Sturisoma guentheri (Regan).

Peru. This example agrees with Regan's figure and account. Scutes 20+16. Sutures on predorsal shield weak, so that it appears as rather large single plate, preceded by 2 more plates to supraoccipital process. Dorsal with traces of faint spots on fin-rays. Caudal with uppermost and lowermost rays produced (tips damaged), and with several dark spots, arranged mostly as transverse bands.

CYCLOPIIDÆ.

Cyclopium sabalo (Valenciennes).

Rio Urubamba, Peru.

Cyclopium chimborazoi sp. nov. Fig. 11.

Head 3; depth 4; D. I, 5; A. I, 6; P. I, 10; V. I, 8; head trifle longer than wide; snout 2 in head length; eye about 12; mouth width about 3; interorbital about 5½; dorsal spine 1⅗; anal spine 1⅗; pectoral nearly 1; ventral 1⅓.

Body moderately long, compressed, deepest at dorsal origin. Caudal peduncle deep, compressed.

Head depressed slightly. Snout long, depressed. Eye high, midway in head length, without distinct eyelids. Mouth broad, transverse, slightly crescentic, falls little before first third in snout length. Buccal disk broad, especially lower lip, which extends back opposite front edge of pupil, and its surface finely papillose. Lateral barbel emanates about midway in snout length, and extends back about opposite hind eye edge. Teeth moderate, most of upper simple, pointed and with slender acuminate tips. Lower teeth bifid, and lateral prong smaller, otherwise like upper. Nostrils moderate, little closer than eyes are to one another, together, and placed about first third in snout length. Interorbital slightly convex.

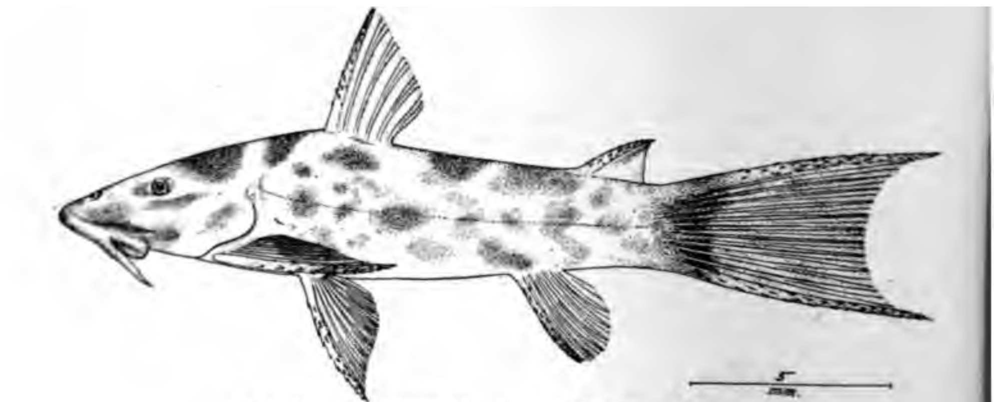

Fig. 11.—*Cyclopium chimborazoi* Fowler. (Type.)

Gill-opening lateral, mostly above insertion of pectoral.

Enlarged rays of fins all with small denticles or spinescent, body [illegible]

Length 24 mm.

Type No. 43,523, A. N. S. P. Junction of the Chanchan River and Chiguancay River, Province of Chimborazo, Ecuador. March, 1911. S. N. Rhoads. Purchased.

Only the type known. Since the appearance of Regan's work in 1904 a number of species have been described and referred to the genus *Cyclopium*.[23] Possibly the nearest approach to the present is *C. cirratum* (Regan)[24] from southwestern Columbia, which, however, would differ in having the ventrals nearly reaching the anal, the pectoral reaching to the ventral base, a smaller head, and a black bar on the caudal fin medianly.

(Named for the Province of Chimborazo, in which the type was secured.)

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[23] Pellegrin, Arc Mérid. Équator., IX (2), 1912, pp. 1–15, Pl. 1. Eigenmann Indiana Univ. Studies, X, No. 8, September, 1912, pp. 13–16.

[24] *Arges cirratus* Regan, Proc. Z. Soc. London, 1912, p. 670.

COLD-BLOODED VERTEBRATES FROM FLORIDA, THE WEST INDIES, COSTA RICA, AND EASTERN BRAZIL.

BY HENRY W. FOWLER.

The Academy has received a number of small collections from the above countries during the past ten years, which I have recently studied. Some include interesting records or new species, and thus they are gathered together to form the present paper. I am indebted to Dr. Thomas Barbour for a review of the amphibians and reptiles listed.

Florida.

The most important collections from this State were made during several winters, in 1904–5, 1906, and 1907, by the late George Bacon Wood, while at West Palm Beach. The marine species were all collected on the ocean front at Palm Beach. Mr. Wood sent photographs or drawings of many of the larger and more abundant and he also ascertained the vernacular names when possible, which are given below in quotations. Under date of March 26, 1909, Mr. Wood wrote me of an example of *Trachypterus* recently taken in a net in the sea. He says it measured 7 feet 2 inches in length and was 14 inches in depth. Later this example was noted in *Forest and Stream*, LXXII, May, 1909, p. 699, with a photograph, and doubtfully referred to as *T. gryphurus*. It was not secured for the Academy.

Sphyrna zygæna (Linnæus). "Hammer-head."

Palm Beach. Mr. Wood reports one obtained at Boca Grande Pass, thirteen feet long, which contained 35 young. Mr. Keeley also reports it and *Carcharias littoralis* at Hawks Park. Mr. Wood noted two other sharks, not preserved, *Ginglymostoma cirratum* and *Galeocerdo tigrinus*, at Boca Grande Pass, the first apparently not before recorded from the east coast. I may also mention that a large example of *Rhineodon typus* A. Smith, was taken at Knight's Key on June 1, 1912, though it has already been recorded by Dr. Gudger. I examined it while on exhibition, in August, 1913, at Atlantic City, N. J.

Pristis pectinatus Latham. "Saw-fish."

Two large examples taken at Fort Pierce, and the photograph sent by Mr. Wood.

Ætobatus narinari (Euphrasen). "Stingaree."

Mr. Wood obtained it at Boca Grande Pass and sent photographs.

Lepisosteus osseus (Linnæus).

I have examined numerous examples in the Philadelphia markets alleged to have been obtained in Florida. Mr. Trimble reported it from the St. Johns River, and also *Amiatus calvus*, from the Ocklawaha.

Tarpon atlanticus (Valenciennes).

Mr. Wood obtained this species at New River, Indian River and Boca Grande Pass, and Mr. Keeley reports it from about Hawks Park.

During 1913, from April 25 to May 7, Mr. Herman T. Wolf made the following interesting measurements (in inches) from 21 examples, freshly killed, from Boca Grande and Captiva Pass, and the Caloosahatchee.

Head.	Depth.	Dorsal.	Anal.	L. l.	Sc. above l. l.	Sc. below l. l.	Predorsal sc.	Snout length.	Eye length.	Maxillary.	Interorbital.	Greatest width of tail.	Dorsal ray.	Maxillary extension front of eye.	Weight on official scales of I. Walton Club.	Calculated weight formula: G.×G.×L. in inches ÷ 800 = lbs.	Greatest girth.	Total length.
11	12¾	11?	20	45	5	6	22	9	1⅝	5⅞	2¾	14½	....	1½	......	56	28¾	55½
12½	14½	13	20	46	5	6	25	8½	1¾	7	3	15	10¾	1¾	96	93½	34½	62½
16	20	13	20	50	5	6	24	9¾	2¼	9⅞	4⅝	20½	17½	2⅞	187	190	43½	79½
15	16½	12	20	46	6	6	22	9	2⅛	9½	4	13¾	17	2½	150	149	39	78
9½	14½	13	21	48	6	7	21?	9	2	9	3½	15½	12½	....	92	95½	34	66
14½	17½	13	20	50	6	6	22	8¾	2¼	8	...	18	15¾	2	152	156	40	78
10¾	15½	13	21	49	6	6	23	9	2⅛	...	3⅝	17½	11½	2⅜	......	121	35½	77
12½	15	12	21	48	6	6	23	8½	1¾	8	...	15½	10¾	....	95	97½	35	64½
12½	16½	13	20	48	6	6	24	9¼	...	...	4¼	....	12	2	111	116	36	72
13¼	...	13	22	48	6	6	25	9	2⅜	8¾	...	16½	....	1¾?	133½	135	38	75
...	12¾	...	21	50	6	6	24	9¾	...	9½	4½	17¼	16¾	2½	......	126	35¾	78
10⅞	14	13	21	50	5	6	23	8?	...	6	...	14	....	2	53	52½	29	50
	15	...	21	49	5	6	25	8½	2⅛	...	...	....	13½	....	65	68½	34½	58½
13¼	...	13	20	48	6	7	24	8¾	...	8⅛	4½	16	12¾	2¼	......	113	36½	68
16?	12½	...	..	49	6	6	23	...	2	...	3⅞	15½	14	2⅜	116¾	121	37	71
11⅛	18	13	20	50	6	6	...	...	1½	5⅞	3	....	10¾	1¾	......	52	28½	52
...	...	13	..	49	6	7	...	8¾	...	9	4½	....	15	2⅜	150	154½	41	73½
12¼	...	12	21	50	6	...	...	8½	...	7½	...	15¾	13¾	1¾	......	90	34½	60
12	13¾	13	20	..	6	..	25	...	2⅛	6¼	...	...	....	....	84	85½	34½	57½
13	...	13	20	50	6	6	24	9¼	2⅜	9¼	4½	19	16½	2¼	140	140½	38½	76
13	16½	13	20	50	6	6	25	9	2⅜	8¾	...	16¾	14½	2¼	124	....	37	74

In all these examples Mr. Wolf found the belly rounded, the tubes of the l. l. much branched, the dorsal always inserted behind the ventrals, and but few color variations. He writes: "River fish are darker in color and may be distinguished at once: the scales are yellowish or yellow, in marked contrast to the brilliant mat-silver

Elops saurus Linnæus. "Ten-pounder."

Palm Beach. Several related forms, not preserved, were found in Florida by Mr. Wood. *Pomolobus pseudoharengus* and *Alosa sapidissima* were both found in the St. Johns River; the last also at Palm Beach. Mr. Wood also found *Albula vulpes* in Biscayne Bay, and Mr. Keeley reports it at Hawks Park, although not very plentiful.

Harengula humeralis (Valenciennes).

Clearwater and Palm Beach. Mr. Wood also found *Abramis crysoleucas* in fresh ponds near the latter locality, and *Erimyzon sucetta* in the St. Johns River.

Dorosoma cepedianum (Le Sueur).

Clearwater.

Synodus fœtens (Linnæus).

Clearwater.

Ophichthus ocellatus (Le Sueur).

Petersburg, in January, 1914 (D. McCadden).

Felichthys marinus (Mitchill). "Sea-cat."

Palm Beach and in salt-water at Sea Breeze. Mr. Keeley found it and *Galeichthys felis* at Hawks Park. Mr. Trimble found *Ameiurus catus* in the St. Johns and *Esox americanus* in sulphur springs near Lake Kerr.

Fundulus seminolis (Girard).

Lake Kerr.

Lucania goodei Jordan.

Lake Kerr.

Jordanella floridæ Goode and Bean.

Big Cypress in Lee County (Baynard) and sulphur wells at Hawks Park (Keeley).

Gambusia holbrookii Girard.

Same localities as the preceding species.

Heterandria formosa Agassiz.

Sulphur wells at Hawks Park.

Mollienisia latipinna Le Sueur.

Clearwater.

Tylosurus notatus (Poey).

Palm Beach and Stuart.

Tylosurus marinus (Walbaum).

Tarpon Springs.

Labidesthes sicculus (Cope).

Lake Kerr.

Mugil curema Valenciennes.

Palm Beach.

Mugil cephalus Linnæus. "Mullet."

Palm Beach and Stuart.

Sphyræna barracuda (Walbaum).

Palm Beach.

Sphyræna borealis De Kay.

Palm Beach.

Syngnathus louisianæ Günther.

Palm Beach.

Hippocampus hudsonius De Kay.

Useppa Island, on west coast in Lee County (H. T. Wolf).

Scomberomorus cavalla (Cuvier). "Kingfish."

Palm Beach, Boca Grande Pass and Stuart. Mr. Wood also found *S. maculatus*, *Sarda sarda* and *Istiophorus nigricans* at Palm Beach.

Trichiurus lepturus Linnæus.

Palm Beach.

Elagatis bipinnulatus (Quoy and Gaimard).

Palm Beach.

Caranx hippos (Linnæus).

Clearwater. Reported at Palm Beach, and occasional at Hawks Park.

Caranx latus Agassiz.

Chænobryttus gulosus (Valenciennes).

Clearwater.

Lepomis incisor (Valenciennes). "Bream."

West Palm Beach, Lake Kerr and Clearwater. Mr. Keeley reports it, and the large-mouth bass from near Hawks Park. Mr. Trimble found *Eupomotis holbrooki* in Lake Kerr.

Micropterus salmoides (Lacépède).

West Palm Beach and Lake Kerr.

Centropomus undecimalis (Bloch). "Snook."

Palm Beach.

Epinephelus morio (Valenciennes).

Palm Beach. Mr. Wood reported *E. striatus* at this locality.

Promicrops guttatus (Linnæus). "Jew-fish."

Stuart and Boca Grande Pass. Mr. Keeley says it has been reported near Hawks Park.

Mycteroperca microlepis (Goode and Bean). "Calico Grouper."

Palm Beach.

Centropristis striatus (Linnæus).

Hawks Park.

Diplectrum formosum (Linnæus).

Clearwater (Pilsbry, Baynard).

Rypticus saponaceus (Schneider).

Palm Beach.

Priacanthus arenatus Valenciennes.

Palm Beach. Previously only known in Florida from Key West.

Lutianus griseus (Linnæus). "Mango Snapper."

Palm Beach, Lake Worth and Hawks Park.

Lutianus apodus (Walbaum).

Palm Beach. Mr. Wood reported the "red snapper," *L. aya*, from Captiva Pass.

Lutianus analis (Cuvier). "Mutton-fish."

Palm Beach.

Lutianus synagris (Linnæus).

Clearwater.

Hæmulon macrostoma Günther.

Palm Beach.

Hæmulon parra (Desmarest).

Palm Beach.

Anisotremus virginicus (Linnæus). "Pork-fish."

Palm Beach.

Orthopristis chrysopterus (Linnæus).

Clearwater. Reported with the next two species from Hawks Park.

Lagodon rhomboides (Linnæus). "Sailor's Choice."

Palm Beach and Clearwater.

Archosargus probatocephalus (Walbaum). "Sheepshead."

Palm Beach and Stuart.

Diplodus holbrooki (T. H. Bean).

Stuart and Clearwater.

Eucinostomus gula (Valenciennes).

Stuart.

Kyphosus sectatrix (Linnæus).

Palm Beach.

Upeneus maculatus (Bloch).

Palm Beach.

Cynoscion nebulosus (Valenciennes). "Trout."

Palm Beach. Also reported at Hawks Park. Mr. Wood secured *Sciænops ocellatus* at Sea Breeze, and Mr. Keeley reports it, and the three following species at Hawks Park.

Leiostomus xanthurus Lacépède. "Spot."

Palm Beach.

Micropogon undulatus (Linnæus). "Croaker."

Palm Beach.

Menticirrhus americanus (Linnæus).

Palm Beach and Stuart.

Chaetodipterus faber (Broussonet).

Palm Beach.

Hepatus bahianus (Castelnau).

Palm Beach.

Balistes carolinensis Gmelin. "Trigger-fish."

Palm Beach and Stuart.

Alutera schoepfii (Walbaum).

Palm Beach.

Lactophrys tricornis (Linnæus).

Palm Beach.

Lagocephalus lævigatus (Linnæus).

Palm Beach.

Spheroides spengleri (Bloch). "Puffer."

Palm Beach. Pine Island in San Carlos Bay (Baynard). *S. maculatus* was also reported at Palm Beach and Hawks Park.

Spheroides harperi Nichols.

Pine Island in San Carlos Bay.

Spheroides testudineus (Linnæus).

Palm Beach. Mr. Wood also found *Diodon hystrix* at this locality.

Chilomycterus schoepfi (Walbaum).

Palm Beach.

Scorpæna brasiliensis Valenciennes.

Palm Beach.

Scorpæna plumieri Bloch.

Palm Beach.

Echeneis naucrates Linnæus. "Shark-sucker."

Palm Beach.

Paralichthys lethostigmus Jordan and Gilbert.

Stuart.

Achirus lineatus (Linnæus).

Palm Beach.

Labrisomus nuchipinnis (Quoy and Gaimard).

Palm Beach.

Hypsoblennius hentz (Le Sueur).

From among barnacles at Hawks Park.

Ogcocephalus radiatus (Mitchill).

Palm Beach.

Siren lacertina Linnæus.

A larval example, with numerous examples of *Gammarus* and *Palæmonetes* from the Kissimmee River, about fifty miles below Kissimmee, by Mr. W. M. Meigs.

Gastrophryne carolinense (Holbrook).

Found at Homestead by Mr. Morgan Hebard. They were discovered under a coquina boulder. Likely the many toads Mr. Hebard saw under stones and boards at Key West in March, 1910. were also this species.

Acris gryllus (Le Conte).

Mr. Hebard found this species exceedingly plentiful in the prairie conditions of the everglades at Miami.

Pseudacris nigritus (Le Conte).

Found under boards, in swampy places, about Miami.

Hyla squirella Bosc.

Atlantic Beach. Only one beaten from the prairie grasses at Miami.

Hyla cinerea Daudin.

Found at Atlantic Beach in the forest undergrowth, where specimens were taken while beating for insects.

Rana sphenocephala Cope.

Clearwater.

Hemidactylus mabouia (Moreau de Jounès).

One taken at Key West, March 14, 1910, by Mr. Hebard. It was found on the plaster wall of a building, where the light shone directly on the wall. These animals hide in crevices during the day. Though three individuals were seen, only the above was captured.

Coluber constrictor Linnæus.

Palm Beach.

Coluber flagellum Shaw.

Clearwater.

Thamnophis sackeni (Kennicott).

Orange Lake in Marion County (Baynard).

Heterodon platirhinos Latreille.

Clearwater.

Agkistrodon piscivorus (Lacépède).

Young from Lake Kerr. Adult from Orange Lake (Baynard).

Sistrurus miliarius (Linnæus).

Two from Lake Kerr.

Crotalus adamanteus Beauvais.

Palm Beach.

Bermuda Islands.

Mr. Stewardson Brown secured a small collection of fishes in Hungry Bay during September, 1905. Another small collection was made early in 1910 by Mr. E. G. Vanatta, and during July, 1914, Mr. C. S. Abbott, Jr., secured a few fishes near Hamilton.

Holocentrus adscensionis (Osbeck).

Two rosy examples from Harrington Sound.

Amia sellicauda (Evermann and Marsh).

One secured in 1905 and presented by Miss S. F. Streeter.

Hæmulon sciurus (Shaw).

Hungry Bay.

Diplodus argenteus (Valenciennes).

Hungry Bay. Many taken.

Eucinostomus harengulus Goode and Bean.

Common in Hungry Bay.

Abudefduf mauritii (Bloch).

One from near Hamilton.

Chætodon capistratus Linnæus.

One from Harrington Sound.

Hepatus hepatus (Linnæus).

Hungry Bay.

Mapo soporator (Valenciennes).

Hungry Bay.

Labrisomus nuchipinnis (Quoy and Gaimard).

Near Hamilton.

Labrisomus lentiginosus T. H. Bean.

One caught on hook, like last, and in same locality.

Bufo marinus (Linnæus).

Adult from Victoria Park and eight young from Hamilton.

Eumeces longirostris (Cope).

Two examples from the Ducking Stool, taken in February, 1910, and larger 125 mm. long.

CUBA.

Most of the material from this country was presented to the Academy during 1914 by Mr. Charles T. Ramsden, of Guantánamo. A small collection was also received recently from Dr. J. W. Ross, made at Varadero, on the north coast. In 1904 Dr. Henry A. Pilsbry made a small collection at Sancti Spiritus.

Anguilla chrisypa Rafinesque.

One adult from Guantánamo.

Gambusia punctata Poey.

Many from Bahia Honda, about ten miles south of Havana, were obtained by Dr. P. Wiksell, in June, 1913.

Glaridichthys uninotatus (Poey).

One female, same data as preceding. A dark blotch above the anal origin conspicuous.

Girardinus metallicus Poey.

Many examples of both sexes from the Arroyo Honda River at San Carlos in Guantánamo. My specimens show obscure darker

Phyllobates limbatus Cope.

Two examples of this rare toad were presented by Mr. Ramsden, who obtained them at Monte Libano in Guantánamo in 1913.

Gonatodes albogularis Duméril and Bibron.

Four from San Carlos in Guantánamo.

Tarentola cubana Gundlach and Peters.

One example of this rare species was secured July 6, 1914, by Mr. Ramsden at Puerto Escondido, Guantánamo.

Anolis equestris Merrem.

One from Varadero.

Anolis lucius Duméril and Bibron.

One from Sancti Spiritus, which agrees with Cocteau's figure, except that the occipital plate is large and with several scales interposed anteriorly. The occipital plate is also colored as a large conspicuous white spot.

Anolis argenteolus Cope.

Two from tree trunks at Sierra del Maguey at San Carlos.

Anolis sagræ Duméril and Bibron.

Two from Monte Libano in Guantánamo.

Anolis loysiana Cocteau.

One from La Victoria at Monte Toro in Guantánamo.

Anolis argillaceus Cope.

One from Bayate in Guantánamo.

Anolis alutaceus Cope.

One from La Union near Monte Libano and another from Bayate.

Anolis porcatus Gray.

One from Guantánamo in 1913.

Anolis angusticeps Hallowell.

Many from Guantánamo, at Bayate Cerza de Concepcioncita, La Coloura, La Colima, Mal Paso at El Palmar, Alto de La Union, and El Peru at Monte Libano. Dr. Pilsbry also obtained it at Sancti Spiritus.

Leiocephalus carinatus Gray.

Varadero.

Leiocephalus vittatus (Hallowell).

One received from the town Ceigo de Availlia, presented by Mr. E. R. Casey, and one from Sancti Spiritus.

Cœlestus sagræ (Cocteau).

One example of this rare species was obtained at Sancti Spiritus by Dr. Pilsbry. It is much paler than Cocteau's plate, and largely grayish above at present.

Ameiva auberi Cocteau.

Road from Guantánamo to Baracoa. Uncommon.

Amphisbæna cubana Peters.

One from Cienfuegos, obtained by Dr. Pilsbry in April, 1904. Mr. Ramsden also sent one from San Esteban, La Demejagua in Oriente Province. He says it is found under rubbish, and to a great extent under or in the ground, and comes up in ploughing and in deep hoeing.

Typhlops lumbricalis (Linnæus).

Cienfuegos, San Juan di Latran and Majajua, from Dr. Pilsbry in 1904. Mr. S. H. Hamilton also secured it at Santiago de Cuba.

Tropidophis melanura (Schlegel).

Two from Guantánamo, one reddish and the other dark brown.

Tretanorhinus variabilis Duméril and Bibron.

Varadero.

Alsophis angulifer (Bibron).

La Vigia hill at Trinidad, from Dr. Pilsbry.

Leimadophis andreæ Reinhardt and Lütken.

Sancti Spiritus.

Arrhyton vittatus (Gundlach and Peters).

Sancti Spiritus.

St. Thomas Island, West Indies.

The following fishes were obtained by Mr. Henry Warrington in

Harengula macrophthalmus (Ranzani).

Holocentrus adscensionis (Osbeck).

Decapterus punctatus (Agassiz).

Trachurops crumenophthalmus (Bloch).

Caranx latus Agassiz.

Upeneus maculatus (Bloch).

Upeneus martinicus Valenciennes.

Cryptotomus roseus Cope. Fig. 1.

Head 2¾ to 3; depth 3⅘ to 4; D. IX, 10; A. II, 8, I or II, 9, I; scales 23 or 24 in l. l. to caudal base and 1 or 2 more on latter; 1½ scales above l. l.; 5 scales below l. l. to anal origin; snout 2¾ to 4 in head; eye 3⅞ to 5⅔; maxillary 3¾ to 4½; interorbital 5⅕ to 5⅔.

The two larger examples, when fresh in alcohol were generally olivaceous above and brighter or more brilliant on sides. Just

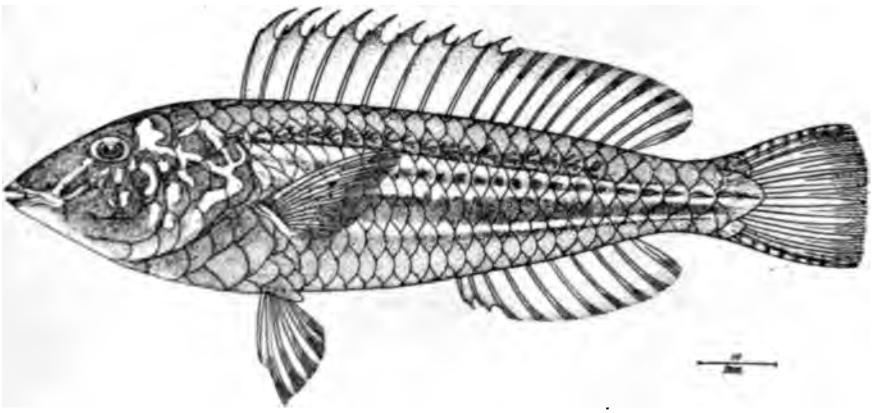

Fig. 1.—*Cryptotomus roseus* Cope.

below lateral line two lengthwise parallel brick-red to deep rosy streaks, upper of which obsolete after falling of l. l. In similar fashion, though reversed, a similar pair of more or less yellowish lengthwise parallel streaks, lower more or less obsolete, especially behind, or broken irregularly into small ill-defined spots. Head dark above, with a reddish streak from front of eye to maxillary, and another parallel one more inferior. Postorbital region with rosy or red blotches, irregular, rather large and well spaced. Upper lip dusky-olive, lower pale or whitish. Each of teeth with median warm brown streak or blotch. Branchiostegal region on throat brilliant rosy-carmine. Obliquely parallel with pectoral base, above or inside and below outside a reddish streak fading out below. Origin

of pectoral above with blackish spot. Dorsal reddish. Pectoral, ventral and anal mostly yellowish. Caudal olivaceous-green with faint vertical streaks. Iris reddish. Color later faded, generally brownish above, whitish below. Fins all brownish. Iris slaty. Teeth whitish. The smaller examples lack most of the brilliant colors of the adults. Length 64 to 110 mm.

This brilliant species was taken in a large seine near Kingston on February 12, 1914. As it is apparently rare and little known, I have given the above notes, and also a figure of the largest example. Cope originally gave a very crude figure and incomplete account of the coloration. His type has been examined and compared in the present study, and although greatly faded there is no doubt as to the identification. *Cryptotomus crassiceps* T. H. Bean,[1] from Bermuda, is also a synonym.

Sparisoma abbotti sp. nov. Fig. 2.

Head $3\frac{1}{5}$; depth $2\frac{4}{5}$; D. IX, 10, I; A. II, 9; P. II, 11; V. I, 5; scales 25 in l. l. to caudal base, and 2 more on latter; 2 scales above l. l. to spinous dorsal origin; 6 scales below l. l. to anal origin; 3 median predorsal scales; 3 median scales on breast before ventral origins; head width 2 in its length; head depth at occiput about 1; snout $2\frac{2}{3}$; eye $4\frac{1}{5}$; maxillary 4; interorbital 4; first dorsal spine 3; first dorsal ray $2\frac{3}{7}$; first anal ray $2\frac{7}{8}$; least depth of caudal peduncle $2\frac{1}{3}$; caudal $1\frac{1}{3}$; pectoral $1\frac{3}{5}$; ventral $1\frac{7}{8}$.

Body moderately ovoid in general contour, compressed, deepest about opposite middle of pectoral, edges mostly rounded, though postventral with slight median keel and one on each side. Caudal peduncle compressed, about long as deep.

Head compressed, deep, profiles similarly convex, and flattened

smallest and somewhat approximated, and posterior on each side largest and flare backward. Both inner buccal folds broad. Tongue large, thick, fleshy, not free. Nostrils simple pores, slightly separated, level with upper part of eye and anterior about last fourth in snout length. Interorbital slightly convex. Preopercle ridge not very distinct, inclined little forward.

Gill-opening extends forward about opposite middle of eye. Gill-rakers about 5+11, slender, fine, scarcely pungent, nearly 3 in filaments, and latter about equal eye. Pseudobranchiæ large as filaments. Branchiostegals slender, graduated. Isthmus convex.

Scales large, cycloid, in even lengthwise series, more or less equal in size, though largest on middle of sides and breast. Ventral with

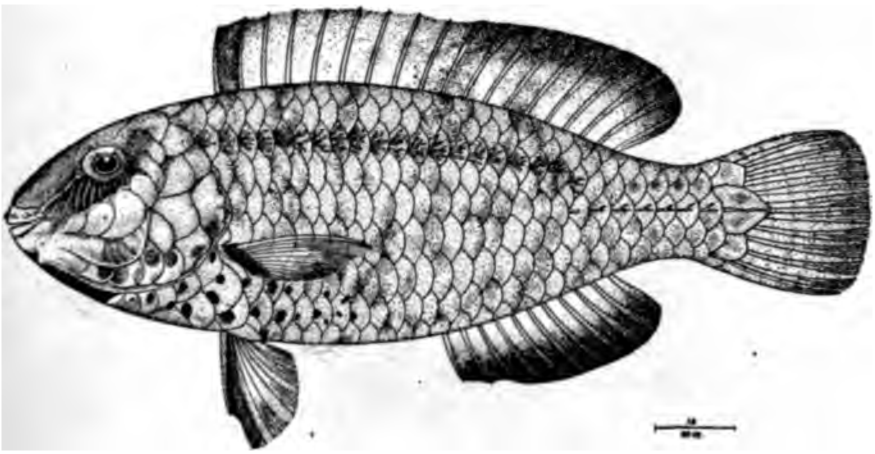

Fig. 2.—*Sparisoma abbotti* Fowler. (Type.)

free pointed axillary scaly flap, about $\frac{1}{3}$ length of fin. Fins naked, except large scales covering caudal base. L. l. complete, high, mostly concurrent with dorsal profile, and falls midway along side of caudal peduncle. Scales in l. l. slightly smaller than those adjoining. Tubes all more or less branched.

Dorsal origin nearly at first third between snout tip and last dorsal ray base, spines all pungent, and edge of fin entire. Anal with spines small and mostly flexible, fin otherwise similar to dorsal. Caudal with hind edge rounded. Pectoral small, first rudimentary ray short and as concealed thorn, fin extending $\frac{3}{4}$ to anal. Ventral inserted about opposite pectoral origin, fin reaching $\frac{3}{5}$ to anal. Vent close before anal.

Color in alcohol generally dull olivaceous, much brighter and

with mottled appearance, due to obscure whitish spots and shades of brownish, when fresh. Lower surface of head and breast with ochraceous tints. Head with dull purplish-brown tints above. A narrow bluish line extends from lower front eye edge to corner of mouth. Iris greenish-yellow. Throat or branchiostegal region brownish or sooty-black. Breast clouded with deep brownish, this shade appearing as a few scattered spots also on lower surface of head and lower sides. Dorsals, caudal and anals dusky-brown. Membrane between first and second dorsal spines dusky, and rayed dorsal largely mottled with dusky on its greater outer portion. Anal pale basally, though outer portion of fin largely blackish its whole extent. Caudal with 5 obscure vertical dark cross-streaks. Pectoral with its entire base, both inside and outside, slaty, fin slightly yellowish basally otherwise, and becomes dusky terminally. Ventral dusky in front, whitish behind.

Length 113 mm.

Type, No. 39,868, A. N. S. P. Kingston, St. Vincent Island, West Indies. February 12, 1914. R. M. Abbott.

This species is allied, if not likely to prove identical, with *Scarus radians* Valenciennes, as interpreted by Jordan and Evermann. *Sparisoma radians*[2] thus differs in the presence of 4 posterior canines, its reddish-brown color, axil with little or no blue, but with a dusky blotch partly hidden by the fin, caudal nearly plain, and one or two more or less distinct whitish bars across the chin. *Scarus lacrimosus* Poey is too imperfectly described to permit of positive identification, though the pectoral is without an axillary spot. Jordan notes[3] a specimen sent by Poey to Cambridge, which had no dark axillary spot, the head plain, though it possessed two strong posterior canines with several smaller pointed teeth in front. At present

TRINIDAD.

Mr. Abbott also made a small collection from this island in February, 1914. *Grapsus maculatus* was obtained on the shore west of Port-of-Spain. *Bithynis ensiculus* and *Pseudothelphusa garmani* were secured in the San Juan River near San Juan.

Pœcilurichthys bimaculatus (Linnæus).

Adult from the San Juan River near San Juan. When fresh the back was olivaceous, and lower surface paler. Sides of head silvery. Iris reddish. Blackish humeral blotch horizontally ellipsoid, and in pale area. Caudal blotch blackish, large, and includes middle caudal rays. Streak of leaden along middle of side. Dorsal and pectoral like back, also anal with exception of front edge which orange, like ventrals. Caudal yellowish basally, tips grayish.

Lebistes reticulatus (Peters).

Many females and a few males from the San Juan River near San Juan. Also three males from the Blue Basin in Blue Basin Falls. These examples are very variable.

Conodon nobilis (Linnæus).

One secured by Mr. Warrington in 1900.

Æquidens pulcher (Gill).

Adult from the St. Joseph River near St. Joseph, and a young example from the Blue Basin.

Eleutherodactylus urichi (Boettger).

One from near Port-of-Spain. In life the throat was brilliant lemon-yellow, though has now faded white in alcohol.

COSTA RICA.

Dr. Philip P. Calvert placed a small collection, made in 1909, in my hands for study. It has not been presented to the Academy. I am indebted to Dr. Calvert for the favor of examining the collection as well as for the notes pertaining to it. Several interesting crustaceans are also contained in it. These are *Palæmon jamaicensis* for the Rio Bananito, *Pseudothelphusia richmondi* from Quebrada Honda near Juan Viñas, and *Potamocarcinus nicaraguensis* from Peralta.

Rivulus isthmensis Garman.

Two from Laguna at Juan Viñas.

Priapichthys annectens (Regan).

Three from the Rio Bananito.

Dendrobates typographus Keferstein.

Two examples, one in life a bright vermilion color and the other gray. Both taken at Philadelphia South Farm.

Dendrobates tinctorius (Schneider).

Holanda Farm.

Agalychius helenæ Cope.

Cartago. Dr. Calvert gives the following note:

"There was an exceedingly handsome frog here, one of which we took to the hotel and kept for some days. When "asleep" its body, exclusive of legs, is 63 mm. (2½ ins.) long. Ordinarily the upper surface of body and legs is a bright pea-green, below the body is speckled white and reddish-brown, with a band of brilliant beautiful blue on each side of the abdomen. We photographed it as we noticed great color changes. When first caught it was pale green. When we took it out of the vasculum at the hotel it was a dark dirty green with pale spots on the back. While we photographed it, it grew light again with paler spots over the back. After night-fall it was again very dark, but although it spent the night in a dark cupboard it was pale green when we first looked at it in the morning and again at 4.30 P.M. When caught it secreted a quantity of sticky mucus having a powerful and disagreeable odor, which it was difficult to remove from the hands. It was able to cling without other support than its toes on the vertical side of our glass graduate. The tips of all the toes (4 on front, 5 on hind feet) are expanded into large fleshy disks with which the frog climbs."

Homalocranium virgatum (Günther).

Juan Viñas.

dachneri. In the earlier accounts of *P. nigricans* little note is taken of the color. Prof. Starks states that Madeira River specimens have the lengthwise lines and cross-bars more distinct than those from Para.

Paecilurichthys bimaculatus (Linnaeus).

Head 3 to $3\frac{1}{4}$; depth $2\frac{1}{4}$ to $2\frac{4}{5}$; scales 32 to 35 in l. l. to caudal base and 2 or 3 more on latter; 7 scales above l. l., rarely 6; 7 scales below l. l., rarely 6; 12 to 15 predorsal scales; snout $3\frac{3}{4}$ to 4 in head; eye $2\frac{3}{4}$ to 3; maxillary $2\frac{3}{5}$ to $2\frac{4}{5}$; interorbital $2\frac{3}{4}$ to 3; length 45 to 58 mm. Six examples.

Among my earlier material belonging to this species, the specimens from the Tocantins headwaters each have a cluster of dusky dots at base of each lateral scale, no other dots on outer portions of scales, where apparently none were ever present, and thus lengthwise series of inconspicuous spots are evident. In these the predorsal scales are interrupted on the anterior median line, though closely and irregularly approximated, several being saddled over the ridge of the posterior half. In the larger of my examples of *Astyanax bartlettii* the predorsal line is more or less interrupted, though in the larger the squamation is mostly destroyed. The Paramaribo *A. orientalis* is pale in color, and in agreement with the Ceará material, though without pigmented dots on the sides at present, and the fallen predorsal scales have left pockets showing they were probably more or less completely placed as saddles. *A. lacustris* shows the scales of the predorsal closely approximated, though only those of the posterior half formed saddles. *A. jacuhiensis* shows the predorsal scales with a nearly complete naked strip in front and without the dark pigment dots, or only very faint sparse ones, at the bases of the scale exposures. The body is also much deeper. Prof. Starks mentions that Lake Extremos, Lake Papary and Ceara Mirim examples have fewer anal rays (25–27), while in the Para material they were more numerous (31–32).[4] Of the first he says: "These are perhaps referable to *Astyanax bimaculatus novæ* Eigenmann, though the lateral band is not so definite as in the picture of the original specimen." *A. bimaculatus novæ* I have been unable to find noticed elsewhere. Finally I have described *A. rupununi*[5] from British Guiana, which in no way differs from Ceará material. It shows the predorsal scales nearly completely forming saddles over the median

[4] Stanford Univ. Publ. (Fishes Stanford Exp. Brazil), March 17, 1913, p. 16.
[5] Proc. Acad. Nat. Sci., Phila., 1914, p. 242, fig. 6.

line, thus allowing for the error of its inclusion in ***Astyanax***, though as a synonym of *P. bimaculatus* it must be suppressed.

Serrasalmus rhombeus (Linnæus).

One 112 mm. long from Barro Alto. The back, above the lateral line is marked with rather numerous, and in most cases more or less dark brownish or dusky vertical spots.

Pygocentrus piraya (Cuvier).

Two examples, 160 and 214 mm. In the smaller specimen the spots are larger, more distinct, and more sparse, also pale, and on basal region of tail larger.

Pimelodella gracile (Valenciennes).

One 172 mm. long. Maxillary barbel reaches anal origin. Outer mental barbel extends only for first fifth in depressed pectoral spine. Adipose fin $2\frac{4}{5}$ in combined head and trunk length.

Plecostomus jaguribensis sp. nov. Fig. 3.

Head, measured to hind edge of occipital process, 3; depth $4\frac{3}{5}$; D. I, 7; A. I, 4; P. I, 5; V. I, 5; lateral scutes from pectoral axilla 25 to caudal base and 2 more on latter; 5 scutes between dorsal base and that of anal; 3 predorsal scutes; head width equals its length, when measured from occipital process medianly behind; head depth at occiput $1\frac{3}{5}$; snout $1\frac{3}{4}$; eye $6\frac{1}{5}$; mouth width $3\frac{3}{4}$, mandibular ramus $6\frac{1}{2}$; interorbital $2\frac{1}{3}$; adipose fin $2\frac{7}{8}$; pectoral spine nearly 1; least depth of caudal peduncle $3\frac{1}{4}$; ventral spine $1\frac{1}{3}$.

Body elongate, moderately depressed with convex surface above and lower surface flattened, anterior profile well convex, and greatest depth at dorsal origin. Caudal peduncle well compressed, and length little less than least depth.

at ends, bifid, 44 in upper jaw and 47 in lower jaw, one of bifurcations always shorter and smaller than other. Inner buccal folds rather wide. Tongue broad and fleshy. Each lateral corner of buccal disk with slender barbel about equal to eye in length. Nostrils large, together, dividing frenum falls little before last fourth in snout length, socket much less than that of eye, and both fall within confines of internasal space. Anterior nostril simple pore with

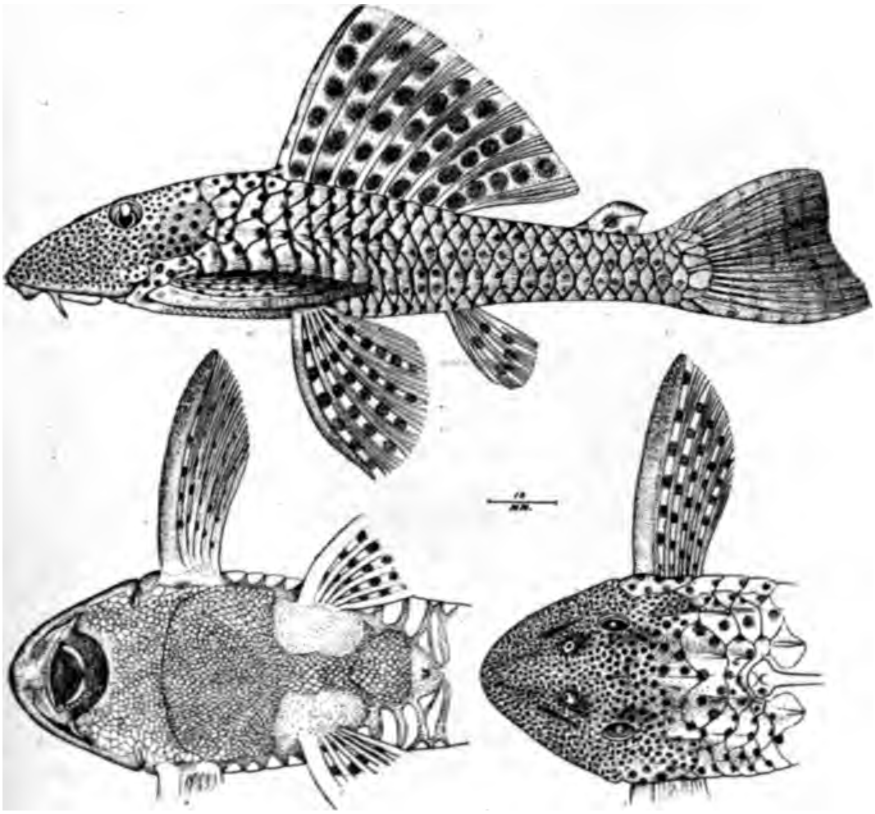

Fig. 3.—*Plecostomus jaguribensis* Fowler. (Type.)

cutaneous flap behind forming valve completely covering slightly larger posterior nostril. Interorbital rather wide, double concave, due to slightly elevated supraoccipital median ridge and each supraorbital also being little elevated. Hind edge of occipital ridge broadly triangular. Opercle large, moderately porous.

Gill-opening small, lateral, oblique, and extends forward about opposite first third in eye. Isthmus broad, about $1\frac{1}{10}$ in snout.

Body everywhere minutely spinulose. Scutes on back slightly carinate, and lateral series obsoletely so anteriorly. None of scutes carinate below adipose fin. Six scutes between dorsal and adipose fin. Occipital process bordered only by median scute behind. Edge of gill-opening bordered with slightly enlarged spinules. Lower surface of head and abdomen covered with small granular scales, all densely and minutely spinulose. Fin spines all spinulose, those on outer edges of pectoral and ventral larger and form rather regular rows more pronounced terminally. Outer surfaces of fin rays minutely spinulose. L. l. evident as simple small pores extending back, one in each suture, between scutes forming series from median hind edge of opercle.

Dorsal origin nearly midway between snout tip and origin of adipose fin, and depressed spine (damaged) apparently moderate. Adipose fin with strongly compressed large bent spine, $1\frac{3}{5}$ to caudal base, and inserted little behind last third in space between dorsal origin and caudal base. Anal inserted slightly before hind edge of dorsal base, or about midway between pectoral axil and caudal base, depressed fin extending $2\frac{1}{5}$ to latter. Caudal moderate (damaged), well emarginate behind ? and lower lobe longer. Pectoral spine large, compressed, reaches about $1\frac{2}{7}$ to anal origin. Ventral inserted close behind dorsal spine base, spine long, tapers to rather flexible point which extends back opposite hind anal ray base. Vent at last fifth in space between ventral and anal origins.

Color in alcohol brown above, paler or more or less whitish below, faded with creamy tints. Iris slaty, pupil darker. Head above rather finely spotted with pale dusky, spots closer, smaller and more numerous on muzzle, interorbital and cheek. Back and costal

Also No. 39,931, A. N. S. P., paratype, same data. Head 3; depth 4¼; D. I, 7; A. I, 4; lateral scutes 26 to caudal base and 2 more on latter; snout 1¾ in head; eye 5⅗; mouth width 3; interorbital 2⅗; length 103 mm.

Related to *P. auroguttatus* (Kner). In that species the dorsal spots are larger and ill-defined and the space between the ventrals is mostly granular. Kner's figure shows the granules sparsely irregular on the breast, whereas in the present species they are mostly uniform. Other allied species, which agree in having the occipital bordered by a single nuchal scute, are *P. wuchereri* Günther and *P. unæ* Steindachner. The former has two series of spots on each dorsal membrane and the region between the ventrals is naked or with but few granules. In the latter species the scutes on the belly are reduced to a minimum. *P. lexi* R. Von Ihering, *P. variipictus* R. Von Ihering and *P. ancistroides* R. Von Ihering all differ in coloration.

(Named for the Rio Jaguribé.)

Loricariichthys derbyi sp. nov. Fig. 4.

Head, measured to hind edge of gill-opening 5¼; depth 9¼; D. I, 7; A. I, 5; P. I, 6; V. I, 5; scales 31 in lateral series to caudal base, lateral keels united or approximated after 19 scales; 22 scales behind dorsal; 3 predorsal scales; head width $1\frac{1}{10}$ in its length; head depth at occiput 2⅕; snout 1¾; eye 5; mouth width 4; interorbital 3½; dorsal spine 1⅕; anal spine 1⅕; pectoral spine 1⅓; ventral spine 1⅗.

Body slender in profile, deepest at dorsal origin, and well depressed. Caudal peduncle well depressed, long, and surfaces similarly widely convex above and below.

Head moderately long, depressed, broadly convex above and more or less flattened below. Snout convex over surface, profile also very slightly convex, and length about ¾ greatest width opposite front of eyes. Eye moderate, with eye-socket well notched behind, general form ellipsoid, and center falls about last third in head length. Mouth anterior or slightly before middle in snout length, transverse, and jaws firm. Inner edge of each mandibular ramus with 5 fine, slender teeth, close-set and uniserial. Upper jaw with 10 similar smaller, inconspicuous teeth. Buccal disk elongate, hind edge and outer surface of lower lip entire, though front edge of disk laterally and before each barbel fringed. Lateral barbel short, about ¾ in eye. Tongue broad, fleshy, apparently not free. Nostrils together, within an aperture, but slightly less than eye length, also

extend well into front interorbital region. Internasal space $2\frac{1}{3}$ in interorbital. Cheeks level or very slightly convex. Interorbital mostly flattened medianly, and as supraorbital ridges slightly elevated of somewhat concave appearance. Opercle large, rather porous. Supraoccipital wide, completely divides truly first predorsal scale.

Gill-openings lateral, extend forward about opposite hind edge of eye. Gill-rakers about 3+8 short, firm points, about $\frac{1}{4}$ length of gill-filaments, and latter about 2 in eye. Isthmus broad. Branchiostegals broad.

Scales or scutes, all more or less minutely spinescent. Scutes on belly in rather irregular rows, anteriorly 5, antero-medianly 3,

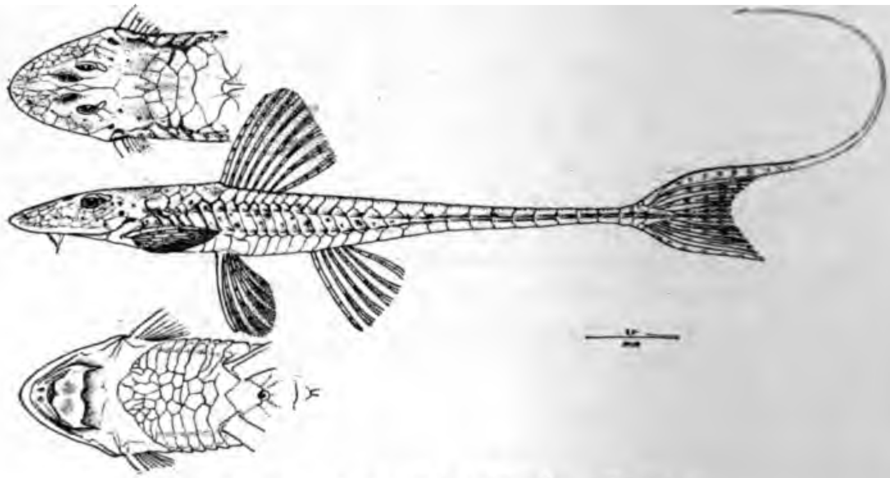

Fig. 4.—*Loricariichthys derbyi* Fowler. (Type.)

outer or upper and lower enlarged, especially former, which conspicuously compressed and osseous. Pectoral reaches ventral, spine rather flexuous at tip, equals longest rays. Ventral inserted slightly before dorsal origin, spine long and flexuous, and extends back slightly beyond front of anal. Vent slightly nearer ventral than anal origin.

Color in alcohol dull brownish above, mottled obscurely with dark towards upper lateral regions. Lower surface of body immaculate whitish. Fins pale brownish, rays and spines all rather finely spotted dusky. Several dusky spots along side of head. Iris slaty.

Length 175 mm. (caudal tip damaged).

Type, No. 39,932, A. N. S. P. Rio Jaguribé at Barro Alto, Brazil. November, 1913. Mr. C. F. Derby.

Also No. 39,933, A. N. S. P., paratype same data. Head $5\frac{1}{2}$; depth 9; D. I, 7; A. I, 5; scales 31 to caudal base and 1 more on latter; scales approximated after first 19; snout $1\frac{3}{4}$ in head; eye $4\frac{1}{3}$; mouth width 4; interorbital $3\frac{2}{5}$; length 150 mm. (caudal tip damaged).

This species appears to be related to *Loricaria spixii* Steindachner, which differs in having the lateral keels approximated after the twenty-third scale, fewer scales in transverse series across the belly, and in the nasal sockets not extending into the anterior interorbital region. From most all other species *L. derbyi* differs in the enlarged uppermost caudal ray.

(Named for Mr. C. F. Derby.)

Lebistes reticulatus (Peters).

Three examples 15 to 30 mm. They all show a blackish ocellus on side of back just before dorsal fin. The largest example also has about a dozen vertical streaks made up of the darker olive ground-color and a dusky streak transversely over dorsal near base. These examples were obtained near the coast.

Tropidurus torquatus (Wied).

One example, 187 mm.

A FURTHER CONTRIBUTION TO THE KNOWLEDGE OF THE ORTHOPTERA OF ARGENTINA.

BY JAMES A. G. REHN.

In these PROCEEDINGS there recently appeared a paper by the present author entitled, "A Contribution to the Knowledge of the Orthoptera of Argentina."[1] This study was based wholly on material collected by Mr. P. Jorgensen, of Buenos Aires, and submitted to us for study by that gentleman and Mr. Esben Petersen, of Silkeborg, Denmark. Since the appearance of the above-mentioned paper, several additional collections from Argentina, made almost wholly by Mr. Jorgensen, have been received from the same persons and, in addition, a small but very interesting series from Mr. Carlos Lizer, of Buenos Aires.

The combined material represents quite a few localities supplementary to those given in the previous paper, while thirty-eight species are additional to the one hundred and sixty-two there discussed.

The total number of species here treated is one hundred and fourteen, of which nineteen are now recorded from Argentina for the first time, while three species are new to science. The number of specimens in the present series is four hundred and fifty-eight.

In the tabulation given on page 275 of our previous paper, there

DERMAPTERA.

Family LABIDURIDÆ.

Labidura xanthopus (Stål).

La Cumbre, Prov. of Cordoba. (Lizer.) One male.

This individual is identical with, though very slightly smaller than, the specimen from Puerto Bertoni, Paraguay, recorded by us as *Demogorgon batesi.*[2] Burr[3] now considers the genera *Labidura* and *Demogorgon* to be inseparable and synonymizes *batesi* of Kirby under the older name *xanthopus*, which action, as far as we can determine from our material and the literature, is correct. Stål described the species from Rio Janeiro and Buenos Aires, while Borelli has recorded it from Salta, province of Salta, Argentina.

Family LABIIDÆ.

Labia minor (Linnæus).

Buenos Aires. (Lizer.) One male.

The only previous Argentine record for this widespread species is from Concordia (Borelli, Bollet. Mus. Zool. Anat. Comp. Torino, XVII, No. 418, p. 6).

Family FORFICULIDÆ.

Doru lineare (Eschsch.).

Misiones. January, 1911. (Jorgensen.) Two males, four females.

ORTHOPTERA (s. s.).

Family BLATTIDÆ.

Subfamily PSEUDOMOPINÆ.

Pseudomops neglecta Shelford.

Misiones. January 1, 1911, March 31, 1909, December 10, 1909. (Jorgensen.) Three males, one female.

Florincia, Rio Tapenaga, Province of Santa Fé. Two females.

Alto Pencosa, Province of San Luis. December 20–22, 1908. (Jorgensen; from composite *Ximenedia microptera.*) Five males.

In none of the above-listed males is there any trace of the pale antennal annulus referred to by Shelford and Rehn as occurring in the female. The single female here listed lacks the greater portion of the antennæ. The latter specimen has the tegmina quite piceous, with only the marginal field and the edging of the region of the costal

[2] Entom. News, XXII, p. 247.
[3] Trans. Entom. Soc. London, 1910, p. 185.

veins straw colored, although the coloration of the pronotal disk and of the limbs is normal. The Alto Pencosa and Florincia specimens have the region of the costal veins of the tegmina almost as yellowish as the pronotal margin. The range of the species is extended considerably westward by the Alto Pencosa record.

Ischnoptera rufa Brunner.

Misiones. December 8, 1909. (Jorgensen.) One male.

Ischnoptera vilis Saussure.

Buenos Aires. (Lizer.) One male.

La Cumbre, Prov. of Cordoba. (Lizer.) One male, one female.

Misiones. January, 1911. (Jorgensen.) One male.

The above males have been compared with Paraguayan specimens of the same sex. The Buenos Aires individual has the interocular portion of the occiput quite rufescent, a condition not found in any of the other specimens examined. The female, which sex was previously unknown, has abbreviate lateral non-attingent sublanceolate tegmina, much as in the North American *I. johnsoni*, from which it can be readily separated by the slenderer build, relatively larger and broader head, more transverse pronotum, more tapering tegmina and shorter, more robust cerci. The measurements of the female are as follows: length of body, 14.8 mm.; length of pronotum, 4.2; greatest width of pronotum, 5.5; length of tegmen, 3.6.

The only previous record of the species from Argentina is that from Corrientes by Saussure.

Ischnoptera marginata Brunner.[4]

Misiones. January, 1911, December, 1910, December 1 and 20, 1910. (Jorgensen.) Two males, four females.

Ischnoptera brasiliensis Brunner.

Blattella germanica (Linnæus).

Misiones. July 30, 1909. (Jorgensen.) One male.

Mendoza, Prov. of Mendoza. (A. C. J. Haarup.) One male.

Buenos Aires. (Lizer.) One male, one female.

***Blattella conspersa** Brunner.

Misiones. January, 1911. (Jorgensen.) One male.

This specimen fully agrees with the original description of the species, previously known only from Brazil and Sapucay, Paraguay.

Ceratinoptera puerilis new species.

Type: ♂; Misiones, Argentina. July. 30, 1909. (P. Jorgensen.) [Acad. Nat. Sci. Phila., type no. 5230.]

In general form this species is apparently closest to *C. otomia* (Saussure)[5] from Mexico, from which, however, it differs in the larger size, the more extensive tegmina, which reach to the base of the fifth abdominal segment, the more rounded distal margin of the tegmina, the emarginate supra-anal plate and the different coloration.

Size medium; form subovoid; surface polished. Head with only the outline of the occiput visible cephalad of the pronotum; eyes separated by nearly twice their width; antennæ in length exceeding the body. Pronotum transverse; cephalic and lateral margins regularly arcuate, very faintly flattened dorsad of the head, caudal margin arcuato-truncate. Tegmina slightly more than one and one-half times as long as the pronotum, reaching to the base of the fifth abdominal segment, broad, the greatest width subequal to the length of the pronotum and contained one and one-half times in the tegminal length; costal margin very gently arcuate, strongly rounding distad to the broadly rounded distal margin, sutural margin nearly straight; marginal field broad and short, anal field subpyriform, the anal sulcus reaching the sutural margin nearly two-thirds the length of the latter from the base; venation distinct, discoidal vein with six rami toward the costal and disto-costal margin. Wings minute. Abdomen from near the base narrowing in width distad; supra-anal plate transverse, moderately produced mesad,

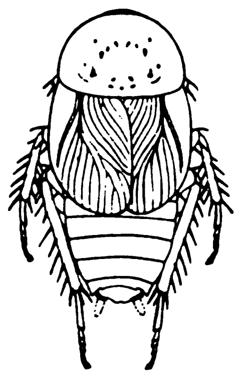

Fig. 1.—*Ceratinoptera puerilis* new species. Dorsal outline of type. (× 3.)

[5] Revue et Magasin de Zoologie, (2), XX, p. 98 (1868).

arcuato-emarginate laterad, distinctly but shallowly V-emarginate mesad; cerci damaged; subgenital plate transverse, emarginato-truncate mesad, provided laterad with articulate styles of moderate length. Cephalic femora with the ventro-cephalic margin having four median and three distal spines, between which groups the margin is provided with a number of spinulations. Median and caudal femora well spined ventrad; caudal metatarsi subequal to the remainder of the tarsal joints in length. All of the tarsi with distinct arolia between the claws.

General color of head, disk of pronotum, of greater portion of tegmina when in repose position over the thoracic segments, coxæ and of limbs raw sienna, the lateral portions of pronotum and marginal field of tegmina subhyaline. Dorsum of abdomen largely blackish mesad, the lateral portions of the segments increasingly of the general color distad; ventral surface of the abdomen mesad of the general color, broadly bordered laterad with blackish, very narrowly edged with the pale color, subgenital plate quite solidly and contrastingly blackish. Head with the eyes blackish brown; face marked with bone brown as follows: a clouded bar between the eyes, ventrad of this between the ocelli traces of another weaker one, between the antennæ arcuate line of six spots with another spot ventrad of each antennal scrobe and on each side a single similar one ventrad of this line; palpi tipped with bone brown; antennæ of the general color becoming darker distad. Pronotal disk with six pairs of points and a pair of small clouds of bone brown. Limbs marked with bone brown at the insertion of the spines and at the distal extremity of most of the tarsal joints.

Measurements.

specimen fully agrees with the original description and bears a great superficial resemblance to species of *Periplaneta*.

Subfamily EPILAMPRINÆ.

Epilampra stigmatiphora Rehn.

Misiones. January 1, 1911, February 14, 1911, November, 1910, December, 1909, 1910 and 1911. (Jorgensen.) Ten males.

These specimens are almost all darker than the type, several with the markings considerably darker.

Epilampra verticalis Burmeister.

Misiones. December, 1909 and 1910. (Jorgensen.) Two males.

Both of these specimens have the subgenital plate strongly asymmetrical and, in similar fashion, a projection extending toward the right side.

Subfamily BLATTINÆ.

Blatta orientalis Linnæus.

Buenos Aires. (Lizer.) One male.

Subfamily PANCHLORINÆ.

Panchlora thalassina Saussure and Zehntner.

Buenos Aires. (Lizer.) One female.

Misiones. January 3, 1910 (at light), November 16, 1909. Two females.

The Buenos Aires record is the most southern known for the species.

***Panchlora exoleta** Burmeister.

Misiones. January 3, 1910, November, 1910. (Jorgensen.) One male, one female.

This is the first Argentine record of this widely distributed species, which previously had been recorded from localities extending from Mexico to Brazil.

Subfamily BLABERINÆ.

Monastria biguttata (Thunberg).

Misiones. May 20 and 23, 1909. (Jorgensen.) One male, two nymphs.

Blaptica dubia (Serville).

Buenos Aires. (Lizer.) Two males, one female, one nymph.

La Cumbre, Prov. of Cordoba. (Lizer.) One nymph.

Specimens have also been examined from Cruz del Eje, Prov. of Cordoba; Cordoba, Prov. of Cordoba; Carcarañá, Prov. of Santa Fe and Rosario.

Subfamily CORYDIINÆ.

Melestora fulvella Rehn.

Misiones. January 1, 1911. (Jorgensen.) Two males.

Latindia argentina new species.

Type: ♂; Misiones, Argentina. January 14, 1910. (P. Jorgensen.) [Acad. Nat. Sci. Phila., type no. 5231.]

Apparently closer to *L. pusilla* Saussure and Zehntner (Biol. Cent.-Amer., Orth., I, p. 112) from Tarma, Peru, than to any other member of the genus, agreeing in having the ulnar vein similarly ramose toward the costal margin, but differing in the pronotum being more transverse elliptical with no truncation to the caudal margin, in the more numerous costal veins to the tegmina, in the subreniform shape of the anal field of the same and in the non-annulate antennæ.

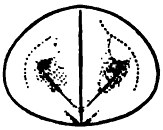

Fig. 2.—*Latindia argentina* new species. Dorsal outline of pronotum of type. (× 8.)

Size small; form elongate elliptical; texture of surface coriaceous, largely short pilose. Head with entire width of vertex visible cephalad of pronotum, the outline of occiput subtruncate; eyes large, interspace between them slightly greater than the depth of a single eye; antennæ moniliform. Pronotum transverse elliptical, the greatest length contained about one and three-eighth times in the greatest width; cephalic margin subtruncate, caudal margin gently arcuate, not at all truncate; a distinct medio-longitudinal sulcus present on almost the entire disk, the latter subimpressed and defined caudad by a subrectangulate indentation, the surface of the disk with about four pairs of oblique, very low strumose ridges; lateral portions of the pronotum sub-

General color bone brown, the limbs paling to fawn color. Pronotum with the lateral portions sayal brown. Antennæ of the general color, non-annulate; eyes blackish.

Measurements.

Length of body	5.8 mm.
Length of pronotum	1.6 "
Greatest width of pronotum	2.2 "
Length of tegmen	7.0 "
Greatest width of tegmen	2.6 "

The type is unique.

Subfamily OXYHALOINÆ.

Chorisoneura minuta Saussure.

Misiones. 1909. (Jorgensen.) One male.

This and Saussure's record of a specimen from Corrientes are the only ones with exact locality known for the species, which was originally described from the Pampas.

Family **MANTIDÆ**.

Subfamily ORTHODERINÆ.

Mantoida burmeisteri (Giebel).

Rio Salado, Prov. of Buenos Aires. Two males.

These specimens fully agree with the individuals from the Misiones previously examined by us, except that the coloration is somewhat darker. The present record considerably extends the range of the species, previously known only from Nova Friburgo, state of Rio de Janeiro, Brazil, and the Misiones territory of Argentina.

***Mantoida tenuis** (Perty).

Mendoza, Prov. of Mendoza. January 17, 1905. (Haarup.) Three males.

This species was previously known only from Brazil.

Orthoderella ornata Giglio-Tos.

Jujuy, Prov. of Jujuy. December, 1911. (Jorgensen.) One male.

This individual is the second male and third specimen known of this remarkable genus and species. Originally described in 1897 from the female sex, taken at Caiza in the Bolivian Chaco, the next record of its capture was made by Chopard,[7] who first described the male sex from a specimen taken at Santiago del Estero, Argentina, in

[7] Bull. Soc. Entom. France, 1911, pp. 141–143, figs. 1, 2.

January. The present individual fully agrees with Chopard's description and figure, except that our specimen is of a brownish instead of greenish phase of coloration.

Subfamily MANTINÆ.

Brunneria brasiliensis Saussure.

Misiones. February, 1911. (Jorgensen.) Three males.

Mendoza, Prov. of Mendoza. (Haarup.) One male, one female.

The Mendoza male is somewhat smaller than the Misiones individual of that sex, but otherwise inseparable. Two of the Misiones males are of a brownish phase of coloration, while the other specimens are greenish. Mendoza is the most southern locality from which the species is known.

Coptopteryx argentina (Burmeister)

Misiones. January, February, 1911; February 4, 1910, December, 1910. (Jorgensen.) Eleven males.

Buenos Aires. (Lizer.) One female.

These specimens vary considerably in size. The individual from Buenos Aires is the smallest female of the species we have seen, its measurements being: length of body, 52.5 mm.; length of pronotum, 17; greatest width of pronotum, 5.5; length of tegmen, 9; length of cephalic femur, 14.1; length of caudal femur, 16.8. The form of the pronotum in several is similar to or strongly approaches that of the Cordillera de Mendoza individual previously mentioned by us.[1] In all of the present series the proximal portion of the marginal field of the tegmina is opaque rufous.

Coptopteryx gayi (Blanchard).

Mendoza. (Haarup.) One male.

La Cumbre, Prov. of Cordoba. (Lizer.) One female.

Thesprotia vidua Saussure and Zehntner.

Misiones. January, 1911, January 15, 1910, March 21 and 26, 1910, April 30, 1910, May 5, 1910, December, 1910. (Jorgensen.) Four males, five females.

Subfamily VATINÆ.

Parastagmatoptera unipunctata (Burmeister).

Tapia, Prov. of Tucuman. Elev. 800 meters. March–April, 1903. (G. A. Baer.) One female. [Hebard Coll.]

Buenos Aires. (Lizer.) One female.

The former is the most elevated locality from which the species has been taken. The distal extremities of the median and caudal femora and the adjacent portion of the tibiæ in the Tapia female are dark brownish, with which color the external face of the cephalic coxæ is also in large part blotched, the proximal portion of the corresponding femora also suffused with the same. The external face of the cephalic femora also has a median spot of brownish on the usual yellowish ground.

Stagmatoptera hyaloptera (Perty).

Tucuman, Prov. of Tucuman. March 16, 1911. (Jorgensen.) One male.

Misiones. March 11, 1907. (Jorgensen.) One female.

Family PHASMIDÆ.

Subfamily ANISOMORPHINÆ.

Agathemera crassa (Blanchard).

La Cumbre, Prov. of Cordoba. (Lizer.) One female.

A pair from Cruz del Eje in the same province have also been examined.

Subfamily CLITUMNINÆ.

Steleoxiphus catastates Rehn.

Misiones. April 12, 1910. (Jorgensen.) One female.

The present individual is slightly larger than the specimen previously recorded by us from the Misiones.[9]

***Ceratites laticeps** Caudell.

Misiones. January, 1911. One female, one immature female.

These specimens agree completely with the original description of the unique type of the species and genus from Sapucay, Paraguay. The adult is of almost exactly the same dimensions as the type,

[9] Proc. Acad. Nat. Sci. Phila., 1913, p. 301.

while the immature specimen is about three-fourths as long, with the subgenital opercule relatively less developed.

Family ACRIDIDÆ.

Subfamily ACRYDIINÆ.

Prototettix lobulatus (Stål).

La Cumbre, Prov. of Cordoba. (Lizer.) One female.

This is the first exact Argentine record from south of the Misiones.

Apotettix bruneri Hancock.

Jujuy, Prov. of Jujuy. February, 1911. (Jorgensen.) One male.

Previously recorded by us from Embarcacion, Salta.

Subfamily EUMASTACINÆ.

***Masyntes tigris** Burr.

Embarcacion, Prov. of Salta. April, 1911. (Jorgensen.) One female.

This specimen fully agrees with a male of the species from Corumbá, Brazil. Bruner's *M. brasiliensis*[10] appears to be very doubtfully distinct, as the differential characters given are very slight, the presumably different measurements being largely accounted for by different general size, and in consequence they are hardly proportional. The present specimen shows the following measurements:

Length of body	26.5 mm.
Length of pronotum	2.8 "
Length of tegmen	5.3 "
Length of caudal femur	14.5 "

This is the first Argentine record for the species.

Cephalocœma costulata Burmeister.

Misiones. January, 1911, February 1, 11 and 14, 1911, March 22 and 24, 1910, April 5, 1910, November 1, 1910, December, 1910. (Jorgensen.) Four males, nine females, one immature male, three immature females.

Posadas, Misiones. (C. Schrottky.) One male.

Rio Tapenaga, Prov. of Sante Fé. One male.

Buenos Aires. (Lizer.) Five males, two females.

La Cumbre, Prov. of Cordoba. (Lizer.) Four immature males, four immature females.

Cephalocœma calamus Burmeister?

Tucuman, Prov. of Tucuman. March, 1911. (Jorgensen.) One male.

We refer the present specimen to this poorly understood species with a query. The fastigium is faintly tapering with the apex little blunted, which feature is not in accord with the original description, but this seems of minor importance, as there is some individual variation in this respect in the group. The size is appreciably less than that originally given for the sex ($3\frac{3}{4}$ inches), but in this our specimen is very close to the male from Brazil measured by Brunner and tentatively referred by him to *calamus*.[11]

The original localities for this species were Villa Occidental, Gran Chaco and the Rio Apa.

Cephalocœma lineata Brunner.

Mendoza. (Haarup.) One male.

Tapia, Prov. of Tucuman. Elev. 600 meters. March–April, 1903. (G. A. Baer.) One female. [Hebard Coll.]

The Tapia record extends the range of the species to the northward.

Subfamily ACRIDINÆ.

Hyalopteryx rufipennis Charpentier.

Misiones. January, 1911, October, 1911, November 2, 1910. (Jorgensen.) Three males, four females.

La Cumbre, Prov. of Cordoba. (Lizer.) One male.

The La Cumbre record is the most southern known for the species.

Truxalis brevicornis (Johannson).

San Lorenzo, Prov. of Jujuy. October, 1911. (Jorgensen.) One female.

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[11] Verh. k.-k. zool.-bot. Gesell. Wien., XL, p. 117.

Orphula pagana (Stål).

Misiones. January 15, 1911, February, 1911, October, 1911, December, 1910. (Jorgensen.) Four males, six females, one immature male.

Amblytropidia robusta Bruner.

Misiones. April 26, 1910. (Jorgensen.) One female.

Amblytropidia australis Bruner.

Buenos Aires. One female. [Hebard Coll.]

Parorphula graminea Bruner.

La Cumbre, Prov. of Cordoba. (Lizer.) One female.

Orphulella punctata (DeGeer).

Misiones. January, 1911, April 5, 1910. (Jorgensen.) One male, three females.

Posadas, Misiones. (Schrottky, no. 17.) One female.

Jujuy, Prov. of Jujuy. February, 1911. (Jorgensen.) One male.

Buenos Aires. One female. [Hebard Coll.]

Fenestra bohlsii Giglio-Tos.

Misiones. January, 1911. (Jorgensen.) One female.

La Cumbre, Prov. of Cordoba. (Lizer.) Three males, one immature female.

The males and adult female are of the usual brownish color phase, while the nymph has the head, pronotum and rudimentary tegmina and wings green with a fine medio-longitudinal yellowish line on the head and pronotum.

Staurorhectus longicornis Giglio-Tos.

Papipappus olarasianus Saussure.

Tucura Catanlil, Department of Limay Centro, Territory of Neuquen. (Lizer.) Two males, one female.

This species was described from the region between the Rio Negro and the Rio Chubut, which area lies southeast of where the present material was taken. No other records are known for the genus and species.

Paulinia acuminata (DeGeer). [*Calopterna acuminata* of authors.]

Buenos Aires. One female. [Hebard Coll.]

Subfamily OMMEXECHINÆ.

Ommexecha servillei Blanchard.

Misiones. January, February and October, 1911, November, 1910, December 20, 1910. (Jorgensen.) Four males, eight females [three pairs in copula].

From this material it is evident that the species is dimorphic in wing length, all three pairs taken in copula differing individually in this respect, two pairs having the males brachypterous and the females macropterous and the other pair having the male macropterous and the female brachypterous. Of the unmated specimens one male and one female are macropterous and four females brachypterous. In the brachypterous individuals the apices of the tegmina vary from straight to strongly uncinate. From the present evidence it would appear that *germari* Burmeister is merely the macropterous phase of the present species, but we do not wish to establish this synonymy until we are better acquainted with Brazilian material of the genus. All of the present series are of a brownish coloration, some more blackish brown than others.

Spathalium stali Bolivar.

Posadas, Misiones. September, 1912. (Schrottky.) One female.

Graea monstrosa Bruner.

La Cumbre, Prov. of Cordoba. (Lizer.) One adult female, one immature female.

This striking form was previously recorded from the country between Bahia Blanca and Cordoba.

Subfamily LOCUSTINÆ.

Coryacris angustipennis (Bruner).

Posadas, Misiones. April 8, 1910. (Jorgensen.) One female.

Misiones. April 8, 1910. (Jorgensen.) One male.

Diedronotus lævipes (Stål).

Misiones. January, 1911. (Jorgensen.) Two males, three females.

Diedronotus discoideus (Serville).

Misiones. March 19–29, April 13–30, May 30, June 12, July 1, 1910. (Jorgensen.) Five males, seven females.

All of the above specimens have the discoidal field of the tegmina more or less maculate.

Elæochlora viridicata (Serville).

Misiones. January 12–18, 1910, January, 1911, February 11, March 12 and 24, November, December, 1910. (Jorgensen.) Eight males, ten females.

La Cumbre, Prov. of Cordoba. (Lizer.) Two adult males, one immature male, one immature female.

The Misiones specimens bear out the facts previously stated by us[12] regarding the divergence of material from this locality from typical Buenos Aires individuals, the only difference from the points there noted being the lack of dull purplish on the humeral regions of two males and the but very faint indication of it in another. The La Cumbre adults are similar in form and coloration to Buenos Aires individuals, but the tegmina and wings are shorter. The nymphs show that the reduction of the median carina in this genus is a feature of specialization, as they have it strongly elevated and considerably arcuate.

Chromacris miles (Drury).

Misiones. March 21, December, 1910. (Jorgensen.) Three males, five females.

La Cumbre, Prov. of Cordoba. (Lizer.) One adult female two

Zoniopoda cruentata (Blanchard).

Misiones. December, 1910. (Jorgensen.) One male, one female.

La Cumbre, Prov. of Cordoba. (Lizer.) Two males, three females, five immature specimens.

Zoniopoda omnicolor (Blanchard).

San Luis. One male. [Hebard Collection.]

Dipenthus paraguayensis Bruner.

Misiones. January, 1911, February 11, March 16 and 19, 1910 (Jorgensen.) One male, five females.

Leptysma filiformis (Serville).

Misiones. January, 1911. (Jorgensen.) One male, one female.

Leptysma obscura (Thunberg).

Misiones. January, 1911. (Jorgensen.) One male, one female.

* **Stenacris interior** Bruner.

Misiones. September 25, 1910. (Jorgensen.) One female.

This species was previously known only from Corumbá and Cuyaba, Brazil, and Puerto Suarez, Bolivia.

* **Inusia gracillima** Giglio-Tos.

Misiones. January 30, 1911. (Jorgensen.) One male.

Buenos Aires. Two females. [Hebard Collection.]

These are the first records of the species from Argentina.

Inusia pallida Bruner.

Misiones. January and January 30, 1911. (Jorgensen.) One male, two females.

These specimens are of the pale green phase of the type.

* **Zygoclistron superbum** Rehn.

Misiones. February 14, 1910. (Jorgensen.) One female.

This is the first record of the genus from Argentina. The species was described from Sapucay, Paraguay, and the present specimen has been compared with paratypes.

* **Aleuas gracilis** Stål.

Misiones. February, 1911. (Jorgensen.) One immature male.

The present specimen appears referable to this species. The general characters are those of *gracilis*, although the caudal tibiæ are blackish distad.

This is the first record of the species from Argentina.

Abracris signatipes (Bruner).

Misiones. December, 1910. One male.

Schistocerca paranensis (Burmeister).

Yuto, Prov. of Jujuy. November, 1911. (Jorgensen.) One female.

Dichroplus elongatus Giglio-Tos.

La Cumbre, Prov. of Cordoba. (Lizer.) Two females.

Buenos Aires. One male, one female. [Hebard Collection.]

Dichroplus punctulatus (Thunberg).

Misiones. January 14, 1910, January, 1911, February 8, 1910, December, 1910. (Jorgensen.)

La Cumbre, Prov. of Cordoba. (Lizer.) One male, three females.

One La Cumbre female has decided clear buffy patches on the caudal femora.

Dichroplus dubius Bruner.

Misiones. January, February, 1911. (Jorgensen.) Five males, nine females.

Dichroplus robustulus Stål.

Misiones. January, 1911, February 11, 1910, March 16, April 5 and December, 1910. (Jorgensen.) One male, eight females.

These specimens fully agree with the material previously recorded by us from the same locality.[13]

Dichroplus bergii (Stål).

Misiones. January and February, 1911, March 24, May 4 and 12, 1910, December, 1910. (Jorgensen.) Four males, eleven females.

La Cumbre, Prov. of Cordoba. (Lizer.) Two males, one immature male.

The caudal tibiæ are decidedly glaucous in all of the Misiones specimens and oil green in the La Cumbre individuals.

This is the first record of the present species from Argentina. The material fully agrees with topotypes from Sapucay, Paraguay.

Osmilia violacea (Thunberg).

Misiones. March 19, April 26, May 3–6, July 1, August 31, October 1, December, 1910. (Jorgensen.) Four males, ten females.

San Lorenzo, Prov. of Jujuy. October 30, 1911. (Lizer.) One male.

Family TETTIGONIIDÆ.

Subfamily PHANEROPTERINÆ.

Burgilis missionum Rehn.

Misiones. January, 1911. (Jorgensen.) Two females.

Hyperophora major Brunner.

Yuto, Prov. of Jujuy. November, 1911. (Jorgensen.) One male.

Ligocatinus olivaceus (Brunner).

Misiones. February, 1911. (Jorgensen.) Two females.

***Homotoicha fuscopunctata** Caudell.

Misiones. October, 1911. (Jorgensen.) One female.

This specimen fully agrees with a female from Sapucay, Paraguay, the type locality, from which point alone the species was previously known.

Theudoria melanocnemis (Stål).

Misiones. January, 1911. (Jorgensen.) One male.

This specimen has the cephalic femora without black, which color is present elsewhere as usual in the species. The only previous Argentine record is that of the type from Buenos Aires. The other known records are from Montevideo, Uruguay, and Puerto Bertoni, Paraguay.

Scaphura nigra (Thunberg).

Tapia, Prov. of Tucuman. Elev. 600 meters. March–April, 1903. (G. A. Baer.) Two females. [Hebard Collection.]

One of these specimens is of the usual atro-chalybeous type, the other approaches variety B of Brunner.

Grammadera clara Brunner.

Misiones. January, 1911. (Jorgensen.) One male.

Buenos Aires. (Lizer.) Two males, one female.

This species was previously known only from Buenos Aires, and Montevideo, Uruguay.

Grammadera albida Brunner.

Misiones. February, 1911. (Jorgensen.) One male.

Phylloptera spinulosa Brunner.

Misiones. January 26, 1910, January, 1911. (Jorgensen.) Two males.

***Phylloptera alliedea** Caudell.

Misiones. January, 1911, December, 1910. (Jorgensen.) Two females.

When compared with a topotypic female from Sapucay, Paraguay, the present material is seen to agree completely, except that the ovipositor is somewhat smaller, in length being 6.5 and 6.7 mm., instead of 8, as described and as in the topotype. This difference is probably geographic. The species is new to Argentina, previously being known only from the type locality.

***Microcentrum angustatum** Brunner.

Misiones. October, 1910. (Jorgensen.) One female.

This is the first Argentine record for the present species, the previous records being Puerto Cabello and Brazil.

Subfamily PSEUDOPHYLLINÆ.

Dasyscelis normalis Brunner.

Buenos Aires. (Lizer.) One female.

Subfamily CONOCEPHALINÆ.

Caulopsis gracilis Redtenbacher.

Buenos Aires. One male. [Hebard Collection.]

The species has been recorded from localities extending from Cuba to Buenos Aires and Montevideo.

Neoconocephalus procerus Redtenbacher.

Buenos Aires. February, 1912. (Jorgensen.) One female.

This is the first record of the species subsequent to its description in 1891 on the basis of Buenos Aires material. The specimen in hand

portions of South America has enabled us to correct several of our previous identifications of specimens as belonging to this species. The material from Sapucay, Paraguay,[15] reported in 1907, we find on re-examination to be *N. vicinus* Karny, subsequently described from Rio Grande do Sul, Brazil, and Paraguay. The Buenos Aires female recorded by us[16] we now find to be the very closely related *N. fusco-marginatus* Redtenbacher.

* **Neoconocephalus fuscomarginatus** (Redtenbacher).

N. saturatus Rehn (*nec* Griffini), Proc. Acad. Nat. Sci. Phila., 1913, p. 375.

Buenos Aires. January 14, 1909. (Jorgensen.) One male.

This is the first record of the species from Argentina, the previous records being from Curitiba, Brazil, and Montevideo, Uruguay.

Homorocoryphus viridis (Redtenbacher).

Misiones. January, 1911. (Jorgensen.) One female.

The only previous Argentine record is from Buenos Aires. The other known records are from Rio Grande do Sul, Brazil, and Montevideo, Uruguay.

Homorocoryphus kraussi (Redtenbacher).

Posadas, Misiones. Elev. 80 meters. March 6, 1909. (Jorgensen.) One female.

The only previous exact records of this species are those of the types from Theresopolis and Rio Grande do Sul, Brazil.

Family GRYLLIDÆ.

Subfamily GRYLLOTALPINÆ.

Gryllotalpa clarazianа Saussure.

Mendoza. 1904–1905. (Haarup.) One female.

This is the first record of the species since its original description in 1874 from Argentina without exact locality. The types were males without apparent wings, while the present specimen has caudate wings, but in every other respect our individual is in accord with the description.

* **Scapteriscus camerani** Giglio-Tos.

Buenos Aires. One male.

This is the first record from Argentina for the species, which was previously known only from Paraguay.

Scapteriscus borellii Giglio-Tos.

Jujuy, Prov. of Jujuy. December 1, 1911. (Jorgensen.) Two females.

[15] Proc. Acad. Nat. Sci. Phila., 1907, p. 390.
[16] *Ibid.*, 1913, p. 375.

Embarcacion, Prov. of Salta. February, 1911. (Jorgensen.) One nymph.

La Cumbre, Prov. of Cordoba. (Lizer.) One male.

Mendoza, Prov. of Mendoza. February 12 and 27, 1908. (Jorgensen.) Two females.

The above records, with our previous ones from the Misiones and Chacras de Coria, Mendoza, and that of Giglio-Tos from San Lorenzo, Jujuy, constitute all the Argentine records of the species.

Nemobius (Argizala) hebardi new species.

When compared with *N.* (*A.*) *brasiliensis*, the present species is found to have a proportionately deeper pronotum, to be decidedly darker in general coloration and to have a decidedly shorter ovipositor.

Type: ♀; Buenos Aires, Argentina. (C. Lizer.) [Acad. Nat. Sci. Phila., type no. 5276.]

Size very large for the genus; form compact; head rather large and rounded, but a little flattened in front. Maxillary palpi as in *brasiliensis*. Pronotum decidedly transverse, but not as much so as in *brasiliensis*, length contained nearly one and seven-tenths times in greatest (caudal) dorsal width, narrowing evenly, but not decidedly cephalad, and with a slight medio-longitudinal sulcus on the cephalic portion. Tegmina elongate, with apex medio-dorsal in position and sharply rounded; longitudinal veins conspicuous, cross-veinlets neither as heavy nor as conspicuous as in *brasiliensis*. Wings very long, considerably more than twice the tegminal length. Ovipositor much shorter than in *brasiliensis*, scarcely more than

Fig. 4.—*Nemobius* (*Argizala*) *hebardi* new species. Outline of ovipositor of type. (× 12.)

Measurements (in millimeters).

♀	Buenos Aires. (Paratype.)	Buenos Aires. (Type.)	Misiones. (Paratype.)
Length of body	10.	10.2	10.2
Length of pronotum	1.7	1.8	1.9
Greatest (caudal) width of pronotum	3	3	3.1
Length of tegmen	6.9	7	6.4
Length of wing	14.9	14.7	14
Length of caudal femur	7	7.1	7.2
Length of ovipositor	3.8	3.6	3.9

Though the color pattern is very obscure in these dark specimens before us, it shows a distinct similarity to that of the usually pale *brasiliensis*, in which species the color pattern is, as a result of the pale general coloration, usually decidedly recessive. In the present species the general coloration is bister, with intermediate channel of tegmina, under parts of body and limbs buffy, the latter flecked with bister dorsad. The occiput is bister striped with three narrow buffy longitudinal lines. The maxillary palpi are pale, clothed with dark hairs and with distal portion of terminal joint briefly infuscated. The entire lower portion of the face and lateral lobes of the pronotum are buffy.

In addition to the type we have examined, a female bearing the same data and one from the state of Misiones, Argentina, taken in February, 1911, by P. Jorgensen. These specimens are all in the collection of The Academy of Natural Sciences of Philadelphia.

We take pleasure in dedicating this species to our co-worker, Mr. Morgan Hebard, whose masterly paper on the North American species of this genus has placed the study of the group on a permanent basis, making possible, by its comprehensive treatment of the subject, the study of the genus as a whole.

Gryllus argentinus Saussure.

Misiones. January, 1911. (Jorgensen.) Two females.

Jujuy, Prov. of Jujuy. April and December, 1911. (Jorgensen.) Two females.

La Cumbre, Prov. of Cordoba. (Lizer.) Three females.

Chacras de Coria, Prov. of Mendoza. Elev. 936 meters. January 9 and 11, 1907 and 1908. (Jorgensen.) One male, two females.

Of this series the Jujuy and Misiones individuals have caudate wings, the others have abbreviate wings. The La Cumbre specimens are more uniformly colored than the others, the Chacras de Coria

individuals showing more contrast between the general coloration and that of the tegmina, one with strongly marked pale tegminal bases; the Misiones representatives are generally pale, while the Jujuy ones are dark with marked pale humeral lines. It seems very probable that *fulvipennis* Blanchard is but a form of this species. The abbreviate wings, supposed to be characteristic of *fulvipennis*, we find to be individual in this as in numerous other species of the genus, and sufficient specimens are in hand to show that the relative proportionate length of the caudal femora and ovipositor varies appreciably, as in other forms of the genus.

Gryllodes laplatæ (Saussure).

Mendoza. 1904–1905; February 20, 1907. (Haarup.) One male, one female.

These specimens are inseparable from individual taken at Carcaraña, Province of Santa Fé.

***Phylloscyrtus canotus** Saussure.

Buenos Aires. (Lizer.) One male.

This is the first Argentine record of the species, which was originally described from "Brazil."

THE GENUS GRYLLUS (ORTHOPTERA) AS FOUND IN AMERICA.

BY JAMES A. G. REHN AND MORGAN HEBARD.

To the systematic orthopterist, the crickets of the genus *Gryllus* have proven to be one of the greatest stumbling-blocks in the order. This is true of the forms found in both hemispheres, but this assertion has especial emphasis when the American forms alone are considered. This is not due to a lack of study, as Scudder and Blatchley have in recent years both endeavored to diagnose certain or all of at least the North American species, using what might be called "conventional" morphological characters, while Lutz, approaching the subject from a biometric point of view, concludes that species in an anyway natural sense do not exist in the genus, in this skepticism representing the other extreme from Scudder, who categorically defines a number of species.

The present authors have been unable in the past to approach the subject with sufficient material to enable them to do more than endeavor to assign certain of their series to various of the forms recognized by Scudder. There has been constant and increasing difficulty in doing this, as, while some individuals would fit certain of the specific descriptions, others would be found agreeing in various features with two or more of the specific diagnoses, the sum total of almost any representation showing an endless complexity of the characters used to differentiate the numerous described forms.

The fact is quickly recognizable that almost all of the descriptions of these species were chiefly concerned with size, coloration (not color pattern), venation (in number of transverse (oblique of Saussure) veins in the male tegmen and number of branches of the mediastine vein in both sexes), tegminal length, degree of development of wings and ovipositor length. Such factors have been found to be of minor importance or of no specific value whatsoever in certain other related genera, and the natural uncertainty of the status of the American forms has led us to undertake a more searching study of these. This work is based on all of the American material of the genus before us, 1,504 specimens. The results explain to our complete satisfaction the reasons for the past confusion, a summary of which is given below.

The genus *Gryllus* is found in America everywhere from southern Canada to Patagonia. Many forms are developed, distinctive in appearance to different degrees, but possessing in not a single instance valid and constant specific characters, with the exception of *Gryllus domesticus*, a distinctive introduced species.

The different manifestations of the only native American species, *Gryllus assimilis*, are in no case sufficiently differentiated or constant to be considered geographic races. They constitute mere variations, the adaptation of this exceedingly plastic species to local environmental conditions. All are in varying degrees unstable,[1] but certain geographic limits naturally bound the distribution of each, thus desert adaptations, such as those described as *personatus* and *armatus*, are never found in the well watered portions of the continent, nor is the tropical adaptation, *assimilis*, found in the extreme northern or southern portions of the range of the species. This is of course explained by the fact that the environmental conditions producing these variants are not found over portions of the range of the species.

The work of Lutz[2] has already demonstrated the error of using length of tegmina, wings and ovipositor as characters of specific importance in the genus *Gryllus*. The mass of evidence upon these features in Lutz's paper is absolutely convincing; from studies of other genera we have found such characters to be of minor importance generally throughout the Orthoptera. Finding no other characters which could warrant specific distinctions in the mass of American material which he carefully bred and studied, Lutz has, however, stated that all the forms of *Gryllus* are conspecific. His examination of the series of females of the genus in the British Museum should have shown him the error of this opinion, but he apparently con-

overlooking characters of real specific value in the exotic series of *Gryllus*.[4]

Gryllus assimilis (Fabricius).

1775. [*Acheta*] *assimilis* Fabricius, Syst. Ent., p. 280. [Jamaica.]
1838. *Gr[yllus] pennsylvanicus* Burmeister, Handb. Ent., II, abth. II, pt. I, p. 734. [Pennsylvania.]
1839. *Gryllus luctuosus* Serville, Hist. Nat. Ins., Orth., p. 335. [♂, ♀: North America.]
1839. *Gryllus abbreviatus* Serville, *ibid.*, p. 336. [♀: North America.]
1841. *Acheta nigra* Harris, Ins. Inj. Veget., 1st ed., p. 123. [New England.]
1854. *Gryllus fulvipennis* Blanchard, Hist. Chile, Zool., VI, p. 32. [♂, ♀: Valparaiso, Coquimbo, etc., Chile.]
1858. *Gryllus lineaticeps* Stål, Kongl. Svensk. Freg. Eug. Resa, Zool., I, p. 314. [♀: San Francisco, California.]
1859. *Gr[yllus] aztecus* Saussure, Rev. Mag. Zool., 2^e ser., XI, p. 316. [♀: Mexico.]
1859. *Gr[yllus] cubensis* Saussure, *ibid.*, p. 316. [Cuba.]
1859. *Gr[yllus] mexicanus* Saussure, *ibid.*, p. 316. [Mexico.]
1862. *G[ryllus] angustus* Scudder, Bost. Journ. Nat. Hist., VII, p. 427. [3 ♀, Cambridge and Cape Cod, Massachusetts.]
1862. *G[ryllus] neglectus* Scudder, *ibid.*, p. 428. [♂, ♀: Massachusetts and Cape Cod, Massachusetts.]
1864. *G[ryllus] personatus* Uhler, Proc. Ent. Soc. Phila., II, p. 547. [1 ♀: Kansas.]
1869. *Gryllus septentrionalis* Walker, Cat. Dermapt. Saltat. Br. Mus., I, p. 18. [♂, ♀: Oajaca, Mexico; west coast of South America; San Domingo.]
1869. *Gryllus luridus* Walker, *ibid.*, p. 18. [♀: Vera Cruz, Mexico.]
1869. *Gryllus determinatus* Walker, *ibid.*, p. 19. [♂, ♀: Jamaica; St. Vincent; San Domingo.]
1869. *Gryllus parilis* Walker, *ibid.*, p. 20. [♂: St. Vincent; Brazil.]
1869. *Gryllus similaris* Walker, *ibid.*, p. 20. [♀: San Domingo.]
1869. *Gryllus angustulus* Walker, *ibid.*, p. 21. [♂, ♀: Jamaica; St. Vincent.]
1869. *Gryllus contingens* Walker, *ibid.*, p. 21. [♀: St. Vincent; Brazil.]
1869. *Gryllus signatipes* Walker, *ibid.*, p. 22. [♂: west coast of America.]
1869. *Gryllus comptus* Walker, *ibid.*, p. 23. [♂: Constancia, Brazil.]

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of *Gryllus* in the British Museum, Lutz confined himself to biometric observations and failed to recognize the specific units involved. The extremes of ovipositor length for this series showed a minimum of 5 mm., which is decidedly shorter than ever found in *Gryllus assimilis* (10.5 to 25.5 mm. in material studied by him, unquestionably referable to *assimilis*, and in our present series 11.2 to 23.2 mm. In most series of the species we find the great majority of specimens to show an ovipositor length measuring between 12.5 and 21.5 mm.).

[4] Lutz also briefly discusses the genus *Atlanticus* in his paper, where from a few specimens it is assumed that similar variations in length of ovipositor and caudal femora exist, such variations demonstrating, in his opinion, the invalidity of the two species for which the names *Atlanticus pachymerus* and *dorsalis* had been used. This conclusion is without foundation, as he totally overlooked the fact that independent of general bulk these two species are separable by excellent morphological characters. Recent studies based upon examples of *Atlanticus* show that at least nine distinct specific units exist, each showing some variation, it is true, in the length of the ovipositor and to a lesser degree of the caudal femora, but the forms have excellent genital and other morphological characters, each species being far less plastic than *Gryllus assimilis*. This would be, in part, the explanation of Lutz's position regarding the Old World forms of *Gryllus*. A deeper study than biometric measurements of two dimensions in these forms would have shown excellent morphological characters for a number of species.

1869. *Gryllus mundus* Walker, *ibid.*, p. 23. [♀: Brazil.]
1869. *Gryllus signatus* Walker, *ibid.*, p. 24. [♀: Venezuela.]
1869. *Gryllus vicarius* Walker, *ibid.*, p. 24. [♂: Pará, Brazil.]
1871. *Gryllus debilis* Walker, Cat. Dermapt. Saltat. Br. Mus., V, Suppl., p. 4. [♂: Chontales, Nicaragua.]
1874. *Gryllus argentinus* Saussure, Miss. Sci. Mex., Rech. Zool., VI, p. 399. [♂, ♀: Brazil; Tarna, Peru; northern Patagonia; Buenos Aires, Bahia Blanca and Rio Negro de Patagonas, Argentina.]
1874. *Gryllus scudderianus* Saussure, *ibid.*, p. 402. [♂, ♀: North America.]
1874. *Gryllus capitatus* Saussure, *ibid.*, p. 405. [♂: Peru; Chile.]
1874. *Gryllus bicolor* Saussure, *ibid.*, p. 405. [♂, ♀: Monte Rico, Guiana.]
1874. *Gryllus peruviensis* Saussure, *ibid.*, p. 406. [♂: Moyabamba, Peru.]
1874. *Gryllus forticeps* Saussure, *ibid.*, p. 407. [♂, ♀: Brazil.]
1876. *Gryllus insularis* Scudder, Proc. Bost. Soc. Nat. Hist., XVIII, p. 268. [1 ♂, 2 ♀: Guadelupe Island, Lower California.]
1877. *Gryllus miopteryx* Saussure, Mélang. Orthopt., fasc. V, p. 320. [♀: Peru.]
1893. *Gryllus galapageius* Scudder, Bull. Mus. Comp. Zool., XXXV, p. 22. [♀: Albemarle Island, Galapagos Islands.]
1897. *Gryllus assimilis* variety *pallida* Saussure, Biol. Cent.-Amer., Orth., I, p. 226. [Durango, Mexico; Presidio de Mazatlan, Sinaloa, Mexico.]
1897. *Gryllus chichimecus* Saussure, *ibid.*, p. 226. [♂, ♀: Ciudad, Durango, Mexico, 8100 feet.]
1901. *Gryllus barretti* Rehn, Trans. Am. Ent. Soc., XXVII, p. 221. (May) [1 ♂, 3 ♀: Cuernavaca, Mexico.]
1901. *Gryllus vocalis* Scudder, Psyche, IX, pp. 267, 268. (Nov.) [♂, ♀: Palm Springs and Los Angeles, California.]
1901. *Gryllus integer* Scudder, *ibid.*, pp. 267, 268. [♂, ♀: West Berkeley to San Diego, California.]
1902. *Gryllus armatus* Scudder, Psyche, IX, p. 293. [♂, ♀: Beaver Dam, Utah; Ehrenberg and Fort Whipple, Arizona.]
1902. *Gryllus rubens* Scudder, *ibid.*, pp. 294, 295. [1 ♀: Auburn, Alabama.]
1902. *Gryllus firmus* Scudder, *ibid.*, pp. 294, 295. [♂, ♀: Brookville, Indiana; Smithville and Pungo (*nec* Dingo) Bluff, North Carolina; Georgia; Sanford and Key West, Florida.]
1903. *Gryllus alogus* Rehn, Proc. Acad. Nat. Sci. Phila., 1902, p. 726. (Jan.) [1 ♀: Albuquerque, New Mexico.]
1903. *Gryllus bermudensis* Caudell, Proc. Ent. Soc. Wash., V, p. 330, (June) [1 ♀, 2 juv. ♂: Bermuda.]
1903. *Gryllus americanus* Blatchley, Orth. Indiana, p. 433. (Sept.) [♂, ♀: eight counties in Indiana.]

is in each wholly different. Other species, such as *Gryllus desertus*, *chinensis*, *afer* and *servillei*, show less striking features, but exhibit a complex of characters which prove them to be distinctive forms, worthy of specific rank. It would be ill advised, however, to attempt detailed diagnoses of the exotic species except in a monographic study of the genus.

Specific Description.—Size variable (length ranging from 14 to 28.8 mm.[6]); form robust (two general types are developed, one, particularly found in typical *assimilis*, somewhat more robust and compact than the other, which latter is the normal condition in the great majority of variants developed in the temperate regions). Head slightly broader than pronotum (except in a rare megacephalic condition: in this there is no flattening of the face at the clypeal suture as found in megacephalic males of *Miogryllus*, and to an even greater degree comprehending the entire face in males of several species of the genus *Scapsipedus*[7]). Pronotum with proportionate length of disk somewhat variable, but with this dimension usually contained in the width about 1.4 times, caudal margin of disk straight to distinctly bisinuate, lateral lobes with ventral margin straight and horizontal, or occasionally weakly declivent cephalad, ventro-cephalic and ventro-caudal angles rectangulate, the former rather broadly rounded, the latter more decidedly so, the caudal portion of the lateral lobes is somewhat pressed inward, particularly ventrad. In length the tegmina vary from less than half to fully the abdominal length, in some phases their apices are situated externo-laterad, though normally mesad. The wings are either developed as complete organs of flight (though never to the extent found in the

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[6] These extremes are nearly equalled in two male specimens before us, both of the *scudderianus* variant and both from Miami, Florida: length of body, 14.5 and 28.5; pronotum, 3.1 and 5.7; caudal femur, 9.1 and 16; tegmen, 9.3 and 17.9; wings, (concealed) and 27; caudal width of pronotum, 4.6 and 8.1 mm.

[7] It is with considerable surprise that we find material of *Scapsipedus limbatus* Saussure (referable to the variety *africanus*, if valid), in material before us from Cuba and Jamaica. The males are easily separable from those of *Gryllus* by the very peculiar head, but the females are instead perfectly normal in this respect; no dark form of *Gryllus* found in America, however, having the transverse yellow markings between the eyes found in the species of *Scapsipedus*. In the present insect the males have a sharply defined band of this color between the ocelli, while the females have an additional band just below, between the ventral margins of the eyes and an elongate triangular mesal spot of the same color below, the apex of which touches this latter band. We mention this species here as females collected at some future time in the West Indies, where the species has almost certainly been accidentally introduced from Africa by man, might easily be confused with *Gryllus*. The genus *Scapsipedus* is African and Oriental, *limbatus* is described from Madagascar, the variety *africanus* by inference from Africa.

species of *Miogryllus*) or are greatly reduced, though perfect and concealed by the tegmina[8] (when greatly reduced in *Miogryllus*, the wings constitute small rounded flattened pads, not folded as in the macropterous condition, and may be termed vestigial rather than reduced). The transverse veins of the male tegmina are normally 3, sometimes 4 (particularly in some South American series where this number is the normal), rarely 5, and very rarely 2 or 6; the speculum is broadly ovate, but somewhat variable in outline, with normally a curved vein dividing it into nearly equal sections. The number of branches of the mediastine vein is variable in the present species and useless as a specific character. The caudal tibiæ have the dorsal margins armed normally with 6 or 7 heavy rigid spines (the number of these spines is seldom 5, except in a very few series and very rarely 8 or more[9]), the distal spurs are 6 in number, the medio-external, medio-internal and dorso-internal being decidedly the longest, of which the medio-internal is normally slightly longer than the others, equalling slightly more than ½ to ⅔ the length of the metatarsus. The male titillatores are very different from those found in either *Gryllus domesticus* or *Gryllus mitratus*, with which species we have alone been able to make this comparison. This organ is found within the subgenital plate of the males of this group and constitutes the repository of a small globular seminal sac which rests upon the subgenital plate, but is enveloped laterad and dorsad by the thin but corneous organ, the parts of which afford the diagnostic features described below. This corneous portion constitutes a thin complex plate, semi-circular in transverse section and composed of a medio-dorsal and two lateral parts. The first of these is produced mesad in an upcurved, rather narrow, triangular plate, with margins weakly

Treatment of the Specific Variants.—In order to place properly the material of this species examined, we have found it quite impossible to group the specimens under any number of varietal units, and in consequence we have devised a system of symbols as given below, by which the coloration, color pattern, tegminal and wing development and size of each specimen recorded at the end of this treatment is defined. We have found that in general certain types do predominate over certain regions. These constitute the bases of many of the supposed species, but in our opinion should be characterized by symbols rather than varietal names, owing to their complexity and the evident fact that none of these are distinct either specifically or as geographic races, and really show only the various phases resultant from varied environmental conditions. In other widely distributed and plastic species we have found similar environmental adaptations,[10] but nowhere in the Orthoptera of America is this carried to the multiplicity and extreme diversity of such variants as in the present species. Should varietal names be used without qualification for such units, even for convenience, the frequent and varied combinations of features, already proven worthless for either specific or geographic racial distinction, would preclude the possibility of proper use of even such names of minor importance for many specimens in every large series studied.

Symbols used to designate the material of this species here recorded.

Coloration of head and pronotum.

A. Black.
B. Black, mouth parts and margins of lateral lobes of pronotum pale.
C. Very dark brown, paler dorsal postocular bar and marking on infra-ocular portion of genæ.
D. Like C, but with mouth parts also pale and between eyes a pale inverted T-shaped marking.
E. Pale, with color pattern strongly defined.
F. Pale, with color pattern weakly defined.

Coloration of caudal femora.

U. Black.
V. Black, with ventro-proximal portion briefly reddish.
W. Black, with ventro-proximal portion widely reddish.
X. Very dark, with reddish suffusion.
Y. Buffy, suffused with darker distad.
Z. Buffy.

[10] *Nemobius fasciatus fasciatus*, *Nemobius fasciatus socius*, *Orchelimum concinnum*, *Conocephalus saltator* and others.

Coloration of tegmina.

a. Unicolorous, dark.
b. Dark, intermediate channel pale.
c. Dark, base and intermediate channel pale.
d. Unicolorous, slightly pale.
e. Slightly pale, intermediate channel very pale.
f. Slightly pale, base and intermediate channel very pale.
g. Unicolorous, very pale.

Macropterism and brachypterism.

u. Tegmina large, wings fully developed organs of flight.
v. Tegmina large, wings much reduced and concealed by tegmina.
w. Tegmina slightly reduced, wings as in v.
x. Tegmina slightly reduced, wings very much reduced.
y. Tegmina decidedly reduced, wings as in x.
z. Tegmina greatly reduced, wings as in x.

Size and form of insect.

With these numbers 0 signifies exceptionally robust form.
1. Size very large.
2. Size large.
3. Size medium.
4. Size small.
5. Size very small.

Much material is found not even to fit exactly any series of these symbols. To overcome this difficulty a few qualifying remarks will often be added or two instead of one of a set of symbols given. Thus a specimen recorded as AB, or VX, or 12, shows it to illustrate a condition intermediate between that signified by the two symbols of a single set given.

degrees the cephalic color pattern found in the species. Other names: *cubensis, aztecus, galapageius, barretti.*

D, suffused Z, (normally d to f, v) 3 (often weakly 0). *mexicanus* Saussure.[11]

This variant is widely distributed over Mexico and Lower California, it is the development toward an arid adaptation of the *assimilis* type and shows great variability. In the United States occasional individuals show a tendency toward, and a few specimens are typical of, this condition in our series taken along the Mexican border of Texas. In this variant the pronotum has the dorsum frequently narrowly bordered laterad by pale yellowish. Other name: *chichimecus.*

EZ, (normally d to g, u), 2 (often weakly 0). *personatus* Uhler.[12]

This variant, a desert adaptation, in which the extreme of recessive coloration and most strongly defined color pattern is reached, is known only from the United States from Kansas, Colorado and central Texas westward. Of all the variants of the species this one shows the most decided indications of a geographic race in process of evolution. It is interesting to note that this variant averages decidedly heavier than the other desert adaptations of the species found in the southwestern United States. Other name: Stål's much older name, *lineaticeps,* appears to represent a transition between this and the *mexicanus* variant.

A, suffused Z, (normally d to g, u), 3. *armatus* Scudder.

In the same regions of the southwestern United States in which the *personatus* variant is found, the present variant also occurs, often very conspicuous on account of its dark head and pronotum which contrast strongly with the much paler remaining portions of the insect. Great variability is shown in the series before us, many differences being found in individuals of every large series, but none showing any approach to the *personatus* variant. Immature individuals of this variant might be mistaken for those of *Miogryllus lineatus*; they have, however, the abdomen broadly infuscated, giving them a barred appearance, while the spines of the dorsal margins of the caudal femora are rarely less than 6 in number, in *M. lineatus* normally 5, and the young of the same are more uniformly yellowish. Other name: *alogus.*

B, suffused Z, (normally d or e, w) 2 (usually weakly indicated 0). *scudderianus* Saussure.

This variant occurs in sandy areas in the eastern United States.

[11] See Plate IV, Fig. 4.

[12] See Plate IV, Figs. 2, 5, 6, 7.

in the north not large or robust (*scudderianus*, 45), but in Florida larger and more robust (*firmus*, 2 weakly 0). It is an adaptation to arenaceous surroundings in these regions. Immature individuals could easily be confused with those of *Miogryllus verticalis*,[13] but in that species the young are more regularly marked with darker colors and normally have 5 spines on each dorsal margin of the caudal femora. Other names: *rubens, firmus, arenaceus.*

AU, (normally ax) 4. *neglectus* Scudder.

This is the darkest variant found in the present species, the maximum development of the condition found also in the two following variants. It is found in the northeastern portion of the insect's distribution, ranging southward in the high Appalachians to northern Georgia and is known from the Piedmont Plateau only in Pennsylvania. Much variability exists and every intergradation with the next two variants is often to be found in the same series.

AV, (normally a or b but ranging to f, x but often u), 3. *pennsylvanicus* Burmeister.

This is the dominant variant of the species in the well watered regions of temperate North America and is found southward to the Gulf coast of eastern Texas. Great variability is exhibited and every intergradation with the variants termed *neglectus* and *luctuosus* is to be found. Other names: *nigra, angustus.*

AW, (normally d but ranging from a to f, w but often u), 3. *luctuosus* Serville.[14]

This variant shows an intensification of the features of the last. It is found throughout the lowlands of the southeastern United States and in the Middle West from Manitoba southward to the arid regions. It also exhibits great variability. The maximum of this condition

pennis appears to be an adaptation similar to the *pennsylvanicus* variant, but heavier, though no more compact, with larger head; under *argentinus* appear to be described numerous adaptations, though typically suggesting the *luctuosus* variant with tegmina f. Saussure's *argentinus* variety *c* is, however, an adaptation similar to the *personatus* variant, but with color pattern scarcely developed.

We have not referred to Walker's names here, as the majority have already been proven synonyms and the descriptions are worthless.

We feel certain that the other described South American species have no further significance than the North American variants discussed above. We have noted that in the mountains, particularly those of arid or semi-arid regions, a degree of plasticity is found greater even than exhibited elsewhere by this most plastic species. Several South American names are doubtless applicable to such manifestations of the species.

Females, as a rule, have the tegminal and femoral markings more decided than in the male sex, thus frequently in the same series the males will show VWa, while the females will average Wb.

As in our other recent papers, the material collected by one or both of the authors is understood to be in The Academy of Natural Sciences of Philadelphia or Hebard Collection.

Specimens Examined.—1504; 570 males, 857 females, 41 immature males and 36 immature females.

Rhode Island.

Providence, IX, 28, 1896, 1 ♀, (AXgx 2), [A. N. S. P.].
Wesquage Beach, IX, 8 to 10, 1913, (H; upland fields), 2 ♀, (AVgx 2; AVgw 2).

Connecticut.

New Haven, VI, 1, 1910, (H.), 1 ♂, 1 ♀,[15] (♂ AVaw 4; ♀ AVgy 4), X, 1909, (H.), 1 ♀, (AVey 2).

New York.

Peekskill, IX, 16, 1912, (E. G. Vanatta), 3 ♀, (AVbx 2), [A. N. S. P.].

Pennsylvania.

South Sterling, IX, 14, 1906, (B. Long), 1 ♂, (AUaw 4), [A. N. S. P.].
Tobyhanna, IX, 1, 1903, (H.), 1 ♂, 1 ♀, (♂ AUaw 3; ♀ AUVay 3).
Lehigh Gap, VII, 12, 1897, 1 ♂, (AUXdw 3), [A. N. S. P.].

[15] Recorded by Hebard as *Gryllus neglectus*.

Ganoga Lake, IX, 2, 1900, 1 ♂, 1 ♀, (♂AUax 3; ♀ AUbx 3), [A. N. S. P.].

Harrisburg, V, 27, 1 ♀, (AVey 2); IX, 27 to XI, 5, 1 ♂, 9 ♀, 1 juv. ♂, 1 juv. ♀, (♂ AVaw 3; 1 ♀ AVby 4; 2 ♀ AVfy 2; 6 ♀ AVey 3), [all Pa. State Dept. Zool.].

Camphill, IX, 12 and X, 19, 2 ♀, (AVbx 2), [Pa. State Dept. Zool.].

State College, IX, 6, 1 ♂ (head nearly black, pronotum, tegmina and caudal femora dark brown, w 3), [Pa. State Dept. Zool.].

Orrtanna, IX, 4, 1 ♀, (AUVbw 2), [Pa. State Dept. Zool.].

Philadelphia, VI, 29 to VII, 8, 1897 and 1898, 2 ♂, 1 ♀, (♂ AVdw 2; ♀ AVau 2), [A. N. S. P.].

Cornwells, IX, 7, 1914, (H.), IX, 11, 1906, (R. & H.), 3 ♂, 7 ♀, (1 ♂ AVfw 2; 2 ♂ AVdw 3; ♀ AV to W, e to g, w to z, 2 to 3).

Chestnut Hill, VIII, 7 to IX, 20, 1903 to 1911, (H.), 3 ♂, 4 ♀, (♂ AUaw 6; ♀ AU, a to b, x to y, 3 to 4).

Mount Airy, IX, 12, 1903, (H.), 1 ♀, (AVfx 2).

Pink Hill, Newtown Square, VI, 19 to VII, 1, 1906 to 1910, (R. & H.; serpentine barrens), 1 ♂, 6 ♀, (♂ AVau 2, ♀ AV, a, b and e, u w and x, 3 to 4).

Newtown Square, VI, 29, 1911, (H. Fox), 1 ♂, (AVdw 3), [A. N. S. P.].

Castle Rock, (G. M. Greene), 1 ♂, (AUax 3), [A. N. S. P.].

Berwyn, IX, 9, 1 ♀, (AUbx 2), [Pa. State Dept. Zool.].

Fern Hill, Chester County, VI, 11, 1911, (R. & H.; serpentine barrens), 1 ♀, (AVew 3); IX, 19, 1908, (R. & H.; serpentine barrens), 1 ♂, 1 ♀, (♂ AUaw 3, ♀ AUby 3).

Addingham, VIII, 13, 1914, (D. Culver), 1 ♀, (AUbx 2), [A. N. S. P.].

Tinicum Island, IX, 9 and 29, 1903 and 1904, (R. & H.; marsh land) 7 ♂, 6 ♀, (♂ A, V and X, dw, 3 to 4; 5 ♀ A, V and W, ex, 3 to 4; 1 ♀ weakly B, WGw 2).

Port Allegany, VIII, 1 to 8, 1904, (H. W. Fowler), 1 ♂, 1 ♀ (AVaw 4), [A. N. S. P.].

Diamond Valley, Huntingdon County, IX, 10, 1905, (R.), 1 ♂, 4 ♀, (♂ AVaw 3; ♀ A, U to V, by 3).

Atsion, X, 8, 1903, (H.; pine barrens), 1 ♂, 3 ♀,[16] (♂ 1 ♀ weakly B, paler X, gw 2; 2 ♀ AVbw 2).

Centre of East Plains, Ocean County, VIII, 24, 1914, (H.; ground oak and pine), 1 juv. ♂, (BY).

Staffords Forge, VIII, 29 and IX, 16, 1905 and 1907, (R. and R. & H.; pine barrens), 5 ♂, 4 ♀, (4 ♂, 3 ♀ A, V to W, d to f, w to y, 2 to 3; 1 ♂ 1 ♀ AYgw 3).

Spray Beach, Long Beach Island, VII, 18 and IX, 6, 1906 and 1907, (B. Long), 1 ♂, 1 ♀, (♂ BYgx 4; ♀ AVfx 4), [A. N. S. P.].

Chairville, VI, 17, 1901, (R.), 1 ♀, (AVex 3).

Ventnor, VIII, 26, 1914, (H.), 1 ♂, 1 ♀, (AV, d and a, w 3).

Formosa Bog, Cape May County, IX, 1, 1908, (H. Fox), 1 ♀, (AVbx 3), [A. N. S. P.].

Townsend's Inlet, Sea Isle City, IX, 8, 1908, (H. Fox; grassy field), 1 ♀, (BYgx 2), [A. N. S. P.].

Sea Isle City, VI, 14, 1912, (H. Fox; washed up), 1 ♂, 1 ♀, (♂ AVcu 2, ♀ AWeu 02), [A. N. S. P.].

Swainton, VII, 20 to 27, 1914, (H.; trapped, molasses jar), 1 juv. ♂, (BY).

Dias Creek, VII, 27, 1914, (H.; trapped, molasses jar), 1 juv. ♂, (BY).

Maryland.

Chestertown, VIII, 20 and 26, 1899, (E. G. Vanatta), 1 ♂, 1 ♀, (♂ wholly pale brown, w 3; ♀ AVby 2), [A. N. S. P.].

Jennings, VI, 24, 1907, (B. Long), 1 ♂, 1 ♀, (AUaw 3, AVbx 3), [A. N. S. P.].

Washington, District of Columbia, VI, 25, 1 ♂, (AVau 3) [A. N. S. P.]; IX, 1883, 1 ♂, (AVaw 2), [Hebard Cln.].

Virginia.

Roslyn, X, 22, 1900, (R.), 1 ♀, (AUVby 3).

North Carolina.

Edenton, VIII, 20, 1908, (R.; moist land), 1 ♂,[17] (Ydw 3).

Newbern, VIII, 24, 1908, (R.), 1 ♀[18], (AVWeu 3).

Raleigh, IV, 16 to IX, 13, 1904, (C. S. Brimley), 9 ♂, 14 ♀,[19] (7 ♂ AWgw, 3 to 4; 1 ♂ AWaw 3; 1 ♂ AVgy 3; ♀ AW, g and e, x and y, 3 to 4), [Hebard Cln.].

Sulphur Springs, near Asheville, V, 10 to VI, 13, 1904, (H.), 7 ♂, 3 ♀,[20] (6 ♂ AVaw 3; 1 ♂ AWfx 3; ♀ AVbw 3).

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[16] Recorded as *Gryllus luctuosus* by Rehn.

[17] Recorded by the authors as *Gryllus rubens*.

[18] *Ibid.*

[19] *Ibid.*

[20] One male recorded by the authors as *Gryllus rubens*, the others as *Gryllus pennsylvanicus*.

Mount Pisgah, 4500 feet, X, 1, 1904, (H.; summit bald), 2 ♂, 2 ♀, (♂ AUax 4; ♀ AVby 3).

Winter Park, IX, 7, 1911, (R. & H.; moist undergrowth of long-leaf pine woods), 2 ♂, 4 ♀, (♂ AVaw 1; ♀ AVb, w and u, 1).

Lake Waccamaw, IX, 8, 1911, (R. & H.), 6 ♂, 4 ♀, (AW, ♂ a ♀ b, u and w, 3 and 4).

South Carolina.

Florence, IX, 6, 1911, (R. & H.), 2 ♀, (AYfw 3; AWeu 2).

Sullivan Island, Charleston County, IX, 5, 1911, (R. & H.; on sandy soil), 2 ♀, (BYc, w and x, 2).

Yemassee, IX, 4, 1911, (R. & H.), 1 juv. ♀, (EZ 2).

Georgia.

Rabun Bald, Rabun County, 4000 to 4600 feet, VIII, 21, 1913, (J. C. Bradley), 1 ♂, (AU), [Ga. State Cln.].

Black Rock Mountain, Rabun County, 3000 feet, V, 20 to 25, 1911, (W. T. Davis), 1 ♂, (AVaw 3), [Davis Cln.].

Tuckoluge Creek, Rabun County, VII, 1910, (W. T. Davis), 1 ♀, (AVWbx 3), [Davis Cln.].

Clayton, 2000 feet, V, 18 to VI, 1909 and 1911, (W. T. Davis, J. C. Bradley), 2 ♂, 4 ♀, (♂ A, V and W, a and d, y 7; 1 ♀ AUau 03; 1 ♀ AVax 3; 1 ♀ AVbx 3; 1 ♀ AEbz 4), [Davis Cln. and Ga. State Cln.].

Atlanta, VII, 10 to VIII, 30, 1910 and 1913, (J. C. Bradley; R. & H.; in pine woods), 1 ♂, 3 ♀, (♂ 2 ♀ AW, d and e, u and w, 2; 1 ♀ AEgw 3).

Vicinity of Stone Mountain, VIII, 3, 1913, (R. & H.; pine woods on edge of bog), 1 ♀, (AWaw 3).

Augusta, VII, 29, 1913, (R. & H.; untilled field among grasses), 4 ♂, (A, WX and Z, dw 3).

Jesup, IX, 1, 1911, (R. & H.), 1 ♀, (AWv 3).

Waycross, V, 10, 1911, 1 ♀, (AVbu 2), [Ga. State Cln.].

Thomasville, III, 18 to XI, 30, 1903 and 1904, (H.: for H.), 20 ♂, 17 ♀,[22] (♂ AW, a or d, u v and x, a to g, u to z, 2 to 4 averaging 6; ♀ A to B, W Y and Z, a to g, u to z, 2 to 4).

Bainbridge, IX, 17 to X, 19, 1910, (J. C. Bradley), 1 ♂, (AWau 3), Ga. State Cln.].

Spring Creek, Decatur County, VII, 16 to 28, 1912, (J. C. Bradley), 1 ♂, 2 juv. ♀, (♂ AWav 3; juv. BZ), [Ga. State Cln.].

Florida.

Jacksonville, VIII, 10 and 25, 1905 and 1911, (R. & H.), 1 ♂,[23] 2 ♀, (♂ AWdu 2; 1 ♀ AWbu 2; 1 ♀ BYdv 3).

Atlantic Beach, VIII, 24, 1911, (R. & H.), 1 ♂, 4 ♀, 1 juv. ♀, (1 ♂ 1 ♀ A, reddish Ydw 3, 3 ♀ AWYdw 3; juv. BZ with dorsal postocular bar also).

Pablo Beach, IX, 5 and 27, 1913, (W. T. Davis) 3 ♂, 3 ♀, (A to B, V to suffused Z, d to weakly f, v, 12 to 3), [Davis Cln.].

Burnetts Lake, XI, 19, 1911, (W. T. Davis), 2 ♀, (A to AB, W, a and d, u and v, 2 and 23), [Davis Cln.].

Gainesville, VIII, 16 and 17, 1905, (R. & H.; pine woods) 2 ♂,[24] 1 juv. ♂, (♂ A and AB, W and WY, d and df, u and w, 3; juv. EFZ).

Live Oak, VIII, 26, 1911, (R. & H.), 1 ♂, 2 ♀, (A, reddish Y and Z, d and f, w and u 3).

Lakeland, XI, 8 to 17, 1911, (W. T. Davis), 3 ♂, 3 ♀,[25] (♂ A, W Y and Z, a and d, u and v, 23 and 4; ♀ A and B, W and Y, b and f, u and v, 2 and 3), [A. N. S. P. and Hebard Cln.].

Tampa, I, 16, 1904, (H.), 1 ♂, 1 ♀,[26] (AWdv 3).

Braidentown, 1 ♀, (B but head black, Zgv 3), [A. N. S. P.].

Punta Gorda, XI, 13 to 16, 1911, (W. T. Davis), 1 ♂, 4 ♀,[27] (♂ AXdv 1; 1 ♀ AXby 1; 3 ♀ BZgv, 1 to 3), [A. N. S. P. and Hebard Cln.].

Chokoloskee, IV and V, 1903, 2 ♂, 1 ♀,[28] (AWdu 3), [Hebard Cln.].

Everglade, V, 1912, (W. T. Davis), 1 ♀,[29] (BZcw 1), [Hebard Cln.].

South Bay, Lake Okeechobee, IV, 30, 1912, (W. T. Davis), 1 ♀,[30] (AWau 3), [A. N. S. P.].

Miami, II, 6 to VIII, 21, 1904 to 1910, (H.: for H.), 11 ♂, 11 ♀, 3 juv. ♂,[31] (♂ A, W to Z, a and d, u to x, 1 to 5; ♀ A to B, W to Z, b to g, u to x, 2 to 3).[32]

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[22] The majority recorded by the authors as *Gryllus rubens*, the others as *Gryllus pennsylvanicus* and *luctuosus*.

[23] Recorded by the authors as *Gryllus rubens*.

[24] *Ibid.*

[25] Recorded as *Gryllus firmus* and *rubens* by the authors.

[26] Recorded as *Gryllus rubens* by the authors.

[27] Recorded by the authors as *Gryllus firmus*.

[28] Recorded by the authors as *Gryllus rubens*.

[29] Recorded by the authors as *Gryllus firmus*.

[30] Recorded as *Gryllus rubens* by the authors.

[31] Recorded as *Gryllus firmus* and *rubens* by the authors.

[32] The extremes of this series show, even for this plastic species, unusual contrast.

Homestead, III, 17 to 19, 1910, (H.) 2 juv. ♂, 1 juv. ♀; VII, 10 to 12, 1912, (R. & H.), 2 ♂,[33] (1 AWdu 3; 1 AZgu 2).

Detroit, VII, 12, 1912, (R. & H.), 1 ♀,[34] (BZew 2).

Jewfish, VII, 11, 1912, (H.; in cracks of sun-baked marsh soil), 2 ♂, 1 ♀,[35] (♂ AZd, u and w, 2 and 3; ♀ BZdw 2).

Long Key, III, 13, 1910, (H.), 1 juv. ♂,[36] (B with dorsal postocular bar, Z).

Key West, III, 15 and 16, 1910, VII, 3 to 7, 1912, (H.: R. & H.), 4 ♂, 3 ♀, 2 juv. ♀,[37] (BZ, d to g, w, 3 to 2).

Indiana.

Crawford County, V, 26, 1902, IX, 9, 1903, (W. S. Blatchley), 1 ♂, 1 ♀, (AWd, w and x, 3 and 4), [Colo. St. Agr. Exp. Sta.]; V, 27, 1904, 1 ♂, (AUax 4), VI, 20, 1902, (both W. S. Blatchley), 1 ♀, *cotype* of *Gryllus americanus* Blatchley, (AVax 3), [both A. N. S. P.].

Posey County, V, 12, 1903, (W. S. Blatchley), 1 ♀, (AUay 34), [Colo. St. Agr. Exp. Sta.].

Michigan.

Pequaming, VII, 22 to IX, 1, 1903, (H.), 35 ♂, 21 ♀,[38] (2 ♂ AUaw 4; 1 ♂ AUbw 4: others, ♂ AV, a or d, w 4; ♀ AVb, w to y, 4).

Gun Lake, VII, 13 to 26, 1912, (M. A. Carriker, Jr.), 1 ♀, 2 juv. ♂, 1 juv. ♀, (♀ AZgx 4), [Hebard Cln.].

Illinois.

Chicago, IX, 9, 1903, (H.; in waste field), 2 ♂, 2 ♀, (♂ AVaw 4; ♀ AVex 4).

Moline, VI, 11, to X, 15, (J. T. McNeill), 1 ♂, 2 ♀, (♂ AVaw 3; 1 ♀ AVbw 2; 1 ♀ Aeu 3), [Hebard Cln.].

Dubois, VI, 21, 1905, (C. A. Hart), 1 ♀, (AUay 3), [Colo. St. Agr.

Mississippi.

Agricultural College, V, 1893, (H. E. Weed), 1 ♂, (A but margins of pronotum pale, Ygw 3), [Hebard Cln.].

Wiggins, IV, 18, (F. M. Jones), 1 ♂, 2 ♀, 2 juv. ♂, 1 juv. ♀, (1 ♂, 1 ♀ AYgw 3; 1 ♀ AWeu 3), [A. N. S. P.].

Biloxi, III, 2 to IV, 24, (F. M. Jones), 2 ♂, 4 ♀, (1 ♂ AWby 3; 1 ♂ AWdw 4; 1 ♀ AYdw 3; 1 ♀ AWew 3; 2 ♀ AZgw 2), [A. N. S. P.].

Manitoba.

Aweme, VI, 21 and IX, 12 to 23, 1909, (N. Criddle), 8 ♂, 4 ♀,[40] (♂ A, UV to VW, a, w to x, 4; ♀ A, UV to strong W, a and b, x and y, 4), [Hebard Cln.].

Nebraska.

West Point, V, 4 to IX, 1, (L. Bruner), 11 ♂, 7 ♀, (♂ AVa, v and w, 2 to 4, majority 3; 5 ♀ AV, a and b, w x and y, 2 to 3; 2 ♀ AWgy 3), [Hebard Cln.].

South Bend, V, 1 ♂, 1 ♀, (A, UV, a and b, w and x, 3); VIII, 11, 1910, (L. Bruner), 1 ♀, (AWbw 3), [all Hebard Cln.].

Lincoln, V to IX, mainly 1893, (L. Bruner), 24 ♂, 14 ♀, 1 juv. ♂, (♂ AV, a and d, v and w, 2 to 3; ♀ A, V to VW, a to d, u v to y, 2 to 3), [Hebard Cln.].

Valentine, 1 ♂, (AVay 4), [Hebard Cln.].

Dismal River, VII, 1 ♀, (AWXbu 3), [Hebard Cln.].

Nebraska City, VI, 1 ♂, 1 ♀, (AUVa, w and x, 3 and 4), [Hebard Cln.].

Broken Bow, VII, 4, 1889, 1 ♂, 1 ♀, (♂AUVaw 3; ♀ AVbu 3), [Hebard Cln.].

Sioux City, V, 1 ♂, (AWdy 3), [Hebard Cln.].

Squaw Cañon, Sioux County, VII, 1892, 1 ♂, 6 ♀, (♂ AVXaz 3; ♀ A, V to W and to X, ab 3), [Hebard Cln.].

War Bonnet Cañon, Sioux County, 1 ♂, 2 ♀, (♂AVdw 4; ♀ AV, a and e, y 4), [Hebard Cln.].

Iowa.

Iowa City, VIII, 1889, (B. Shimek), 1 ♀, (AWey 2), [Hebard Cln.].

Kansas.

Topeka, (F. W. Cragin), 3 ♂, 1 ♀, (A, W and V, a and b, w and x, 3 and 2), [Hebard Cln.].

Barber County, (F. W. Cragin), 1 ♂, 1 juv. ♀, (♂ AWaw 3; juv. D, darkened Z, 2), [Hebard Cln.].

Dodge City, IX, 13, 1909, (H.; grass prairie), 3 ♂, 1 ♀, (♂ A, V to W, ax, 2 to 3; ♀ A with ventral portion of face with pale markings, strongly W, ew 2).

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[40] In part recorded as *Gryllus pennsylvanicus* form *neglectus* by the authors.

Garden City, (F. W. Cragin), 1 ♀, (AYgw 3), [Hebard Cln.].

Syracuse, 3230 feet, IX, 12, 1909, (R. & H.; grass prairie), 1 ♀. (AWaby 2).

Wyoming.

Pine Bluff, 1 ♂, 4 ♀, (A, V to strongly W, a, w to y, 4 and 5). [Hebard Cln.].

Worland, VII, (L. Bruner), 1 ♀, (AVbx 2), [Hebard Cln.].

Sheridan, VII, 27, 1909, (R.; hills with scant grass), 1 ♂, 5 ♀. (♂ AVaw 3; ♀ A, V to W, d to f, xy, 3 to 4).

Mammoth Hot Springs, Yellowstone National Park, VIII, 5, 1904, (H.: in hot spring), 1 ♀,[41] (AWfy 4).

Idaho.

Pocatello, 1 ♀, (AUdu 3), [Hebard Cln.].

Cœur d'Alene, VII, 31, 1889, 1 ♀, (A, reddish Z, dx 3), [Hebard Cln.].

Colorado.

Julesburg, 3460 feet, VII, 29, 1910, (R. & H.), 1 ♀, (AUVaw 3); VIII, 4, 1899, 1 ♂, (AVaw 3), [Colo. St. Agr. Exp. Sta.].

Merino, VIII, 6, 1902, 2 ♀, (AWby 34), [Colo. St. Agr. Exp. Sta.].

Akron, VII, 1891, 2 ♀, (AVW, b and f, u 3), [Hebard Cln.]

Brush, VIII, 24, 1904, (H.; weeds on prairie), 1 ♀,[42] (AWabz 3).

Greeley, IX, 4, 1902, 1 ♀, (AWbx 2), [Colo. St. Agr. Exp. Sta.].

Fort Collins, VI, 10 to X, 6, 1898 to 1903, 9 ♂, 4 ♀, (A, very strongly W to WV, a b d and e, w to y, 2 to 34), [Colo. St. Agr. Exp. Sta.].

Boulder, VIII, 1908, (G. von Krockow), 1 ♂, (AVaw 2), [A. M. N. H.]; X, 29, 1904, (T. D. A. Cockerell), 1 ♀, (AWabz 3), [A. N. S. P.].

Denver, III, 21, (Beale), 1 ♂, 1 ♀, (♂ AUVaw 2; ♀ EZeu 23); 1 ♀, (AWeu 3), [all Hebard Cln.].

Colorado Springs, 1 ♂, 2 ♀, (A, V and UV, a, w and y, 23 to 4),

Texas.

Galveston, VII, 19 to 21, 1912, (H.), 1 ♂, 2 ♀, (♂ AWaw 3; ♀ AB and B, Y and Z, e and g, w, 2 and 23).

Virginia Point, VII, 21, 1912, (H.; under boards in tall salt marsh grasses), 1 ♂, 1 ♀, (♂ AWax 2; ♀ A but mouth parts pale, bx 2).

Dickinson, VII, 20, 1912, (H.; undergrowth of pine woods), 1 ♂, (dark B, dark Y, dw 3).

Rosenberg, VII, 25 and 26, 1912, (H.), 1 ♂, 1 ♀, (♂ AUaw 2; ♀ B, suffused Z, ew 2).

College Station, VIII, 22, 1903, 1 ♀, (A, suffused Z, eu, 1), [Hebard Cln.].

Washington County, IV, 1 ♀, (AWdz 6), [Hebard Cln.].

Victoria, VII, 26 and 27, 1912, (H.), 1 ♀, (AVbu 2).

Beeville, VII, 28, 1912, (H.), 1 ♀, (AVWeu 3).

Corpus Christi, VII, 29, 1912, (H.), 1 ♂, (AVau 3).

Brownsville, VII, 31 to VIII, 5, 1912, (H.; at light), 4 ♂, 6 ♀, (1 ♂ A, suffused Z, au 2; 1 ♂ AVdu 2; 1 ♂ A, suffused W, du 3; 1 ♂ EZgu 2; 3 ♀ weakly B, strongly suffused Z, bu 2; 2 ♀ AUbu, 3 and 34; 1 ♀ EZeu 2).

Shovel Mountain, Burnet County, IX, 5 and X, 4, 1901, (F. G. Schaupp), 3 ♂, 4 ♀, (A to weakly B, strongly suffused Z, d and e, u, 2 to 23); XII, 20, 1901, (F. G. Schaupp), 1 ♀, (AWax 4), [all A. N. S. P.].

Tiger Mills, (F. G. Schaupp), 1 ♀, (AXVay 34), [Hebard Cln.].

San Antonio, IV to VI, 1885, (M. Newell), 1 ♂, 9 ♀, 3 juv. ♂, (♂ AWXaw 3; 3 ♀ A, V to suffused W, b, u and v, 2; 1 ♀ weakly B, reddish Y, eu 2; 5 ♀ A, W to WX, a, y and z, 4), [Hebard Cln.].

Carrizo Springs, V and X, 1 to 25, 1885, (A. Wadgymar), 6 ♂, 7 ♀, 3 juv. ♂, 3 juv. ♀, (1 ♂ A but lateral lobes of pronotum pale, heavily suffused Z, du 2; 1 ♂ A, heavily suffused Z, du 3; 4 ♂ A, V to W, y 4; ♀ B, reddish Z, e, u and x to y, 3 to 2; 1 juv. ♂, 2 juv. ♀, AV; 2 juv. ♂, 1 juv. ♀, BY), [Hebard Cln.].

Laredo, VIII, 10 to 12, 1912, (R. & H.), 1 ♀, (EZfu 2).

Del Rio, VIII, 22 to 23, 1912, (R. & H.; at light), 5 ♂, 16 ♀, (2 ♂, 3 ♀ EZfu 2; 3 ♂ 13 ♀ A with pronotum with lateral lobes occasionally slightly margined with pale, V to much suffused reddish Z, a b d e and g, u, 23 to 34).

Mission, VIII, 26 and 27, 1912, (R. & H.), 2 ♀, (1 ♀ D, suffused Y, du 3; 1 ♀ E, little suffused Z, eu 2).

Hackberry Creek, Brewster County, IX, 2, 1912, (R. & H.), 1 ♂, (AUXax 3).

Dog Cañon, Brewster County, IX, 3, 1912, (R. & H.), 1 ♂, (DE, suffused Z, dw 3).

Moss Well, Chisos Mountains, 4500 feet, IX, 5 to 8, 1912, (R. & H.; occasional in grasses, 2 at light, song a quick, short chirping), 1 ♂, 2 ♀, (AVXa, x and y, 3).

Cañon behind Pulliam Bluff, Chisos Mountains, 4600 to 5000 feet, IX, 7, 1912, (R. & H.), 2 ♂, (AUXaw 3).

Franklin Mountains near El Paso, VII, 11, 1907, (R. & H.; arid mesa slopes among stones), 1 ♂, 1 ♀, 2 juv. ♀, (♂ AVXow 3; ♀ B, suffused reddish Z, by 23; juv. Z, 2 and 3); VIII, 20, 1905, (R. & H.), 3 ♀, (1 ♀ AWdu 3; 1 ♀ B, suffused reddish Z, du 3; 1 ♀ EZeu 2); IX, 16, 1912, (H.; at base, light at night), 8 ♂, 10 ♀, 1 juv. ♂, (♂ A, suffused W to suffused Z, a and d, u, 3 to 34; 8 ♀ A, UV to strongly W and suffused reddish Z, a and d, u, 23 to 3; 2 ♀ EZfu, 3 and 23; juv. EZ with barred abdomen).

El Paso, IX, 16, 1912, (R. & H.; river bottom lands), 2 ♂, (1 ♂ A, much suffused reddish Z, du 23; 1 ♂ weak B, WZgu 3).

New Mexico.

Galliñas Cañon, San Miguel County, (E. J. Oslar), 1 ♂, 1 ♀,[43] (AVa, x and y, 4 and 34), [A. N. S. P.].

Roswell, VIII, 1902, (T. D. A. Cockerell; at light), 1 ♂, (AVdu 23), [A. N. S. P.].

Jemez Hot Springs, 6400 feet, V, 17 to VIII, 13, 1913, (J. Woodgate), 3 ♂, 9 ♀, (♂ A, UV to V, ax 4; ♀ A, U to VW, a but 1 e, y to yz, 34 to 4), [Hebard Cln.].

Albuquerque, 1888, (F. H. Wickham), 1 ♂, 2 ♀, (♂ AXd, y for this sex, 3; 1 ♀ AWby 3; 1 ♀ AWgz 34), [Hebard Cln.]; 1902, (T. D. A. Cockerell), 1 ♀, *type* of *Gryllus alogus* Rehn, (C but pronotum all black, reddish Y, ex 3), [A. N. S. P.].

Fort Wingate, III, 27 to VIII, 14, 1908 and 1910, (J. Woodgate), 6 ♂, 12 ♀, 1 juv. ♂, 2 juv. ♀, (4 ♂ A, U to V, a and d, x, 23 to 3; 1 ♂ A, strongly W, d, z for this sex, 4; 1 ♂ A but mouth parts pale, reddish Z, d, z for this sex, 4; ♀ A but mouth parts pale in 2 small pale specimens, V and W and X to reddish Z, X to extreme Z, 2 to extreme 5; juv. A, V and greatly suffused Z),[44] [Hebard Cln.].

Cloudcroft, 8600 feet, VII, 15, 1907, (H.; under stone, stridulating at night), 1 ♂,[45] (AVax 4).

Highrolls, 7000 feet, V, 31 to VI, 13, 1902, (H. L. Viereck), 3 ♂, 4 ♀, 1 juv. ♀,[46] (♂ AVa, x and y for this sex, 23; ♀ A, V to WX, a, y and z, 2 to 23; juv. AV), [A. N. S. P.].

Las Cruces, VIII, 7, 1 ♂, (B, suffused Z, gu 3), [A. N. S. P.].

Aden, 4300 feet, VII, 21, 1907, (H.; under stones on desert hillside and on grass prairie), 1 ♂, 1 ♀,[49] 1 juv. ♂, (A but mouth parts reddish, suffused reddish Z, d and e, y 3; juv. EZ 3 but with body barred).

Deming, VII, 19, 1907, (R. & H.; at light), 2 ♂, 3 ♀,[50] (2 ♂ 1 ♀ A, WX and suffused reddish Z, a and dg, u and x, 3; 2 ♀ B, suffused reddish Z, gu 3).

Lordsburg, at 4500 feet, X, 15, 1910, (R. & H.; eroded cracks on bare plain), 1 ♀, (EZfu 23).

Nevada.

Las Vegas, 2026 feet, VIII, 9, 1907, (R. & H.; in crack in building), 1 ♂, (head dark brown with mouth parts paler, rest of insect uniform pale brown, w 3); IX, 1 and 2, 1909, (R. & H.; at light), 13 ♂, 15 ♀, (11 ♂ A but palest examples with mouth parts slightly pale, WX and reddish suffused Z, a to de, u, 3 to 34; 6 ♀ A, WX and reddish suffused Z, au 3; 4 ♀ A, suffused Z, dgu 3; 3 ♀ weakly B, weakly suffused Z, dg to g, u 3; 2 ♂ 2 ♀ E, Z and Y, d and f, u 3).

Arizona.

Flagstaff, VII, 5, 1892, 1 ♀, (A, reddish Z, az 34), [Hebard Cln.]; VII, 12 and 13, 1902, (E. J. Oslar), 9 ♀,[51] (1 ♀ AVWav 23; 1 ♀ EYcu 2; 7 ♀ EZ, f and g, u 2), [A. N. S. P.].

Phœnix, IV, 23, 1902, (E. J. Oslar), 1 ♂, 2 ♀,[52] (♂ EZgu 2; ♀ BZgu 3), [A. N. S. P.]; VI, 18 to XI, 18, 1899 to 1901, (R. E. Kunzé), 6 ♂, 19 ♀,[53] (1 ♂ AVdu 3; 1 ♂ D but no postocular bar, Zdgu 3; 2 ♂ Ydul; 2 ♂ EZ, d and dg, u 2; 2 ♀ AVdu 3; 5 ♀ weakly B, reddish Z, dg, u and be, y 3; 1 ♀ EYbu 2; 11 ♀ EZ, f and g, u, 2 to 3), [Hebard Cln.].

Florence, VI, 8, 1903, (C. R. Biederman), 4 juv. ♂, 2 juv. ♀;[54] VII, 17 to IX, 15, 1903, (C. R. Biederman), 1 ♂, 4 ♀,[55] (1 ♂ A, reddish Z, du 3; 2 ♀ A with mouth parts slightly pale, XYeu 3; 1 ♀ B, reddish Z, dgu 3; 1 ♀ EZgu 2), [all A. N. S. P.].

Tucson, 2400 feet, VII, 23 to 26, 1907 and X, 4, 1910, (R. & H.; at lights in streets), 18 ♂, 16 ♀,[56] (1 ♂ 1 ♀ B, reddish Z, d and e, u 2; 17 ♂ 15 ♀ D to F, YZ to Z, d to g, u, 12 to 2).

San Bernardino Ranch, Cochise County, 3750 feet, VIII,

[49] Recorded by the authors as *Gryllus alogus.*

[50] Recorded by the authors as *Gryllus armatus.*

[51] Recorded by Rehn as *Gryllus personatus*, but one female as *Gryllus pennsylvanicus.*

[52] Recorded as *Gryllus personatus* by Rehn.

[53] Recorded by Rehn as *Gryllus personatus, armatus* and *alogus.*

[54] Recorded as *Miogryllus lineatus* by Rehn.

[55] Recorded in part by Rehn as *Gryllus pennsylvanicus* and *personatus.*

[56] Recorded in part by Rehn and Hebard as *Gryllus personatus* and *armatus.*

1905, (F. H. Snow), 1 ♂, 1 ♀,[57] (♂ B, weakly suffused Z, gu 3; ♀ AWYdu 3), [A. N. S. P.].

Carr Cañon, Huachuca Mountains, VIII, 1905, (H. Skinner). 2 ♂, 7 ♀,[58] (2 ♂ 4 ♀ DE and E, suffused Z to Z, d and e, u, 3 to 2; 3 ♀ A but mouth parts pale reddish, reddish Y and Z, byz, 3 and 34), [A. N. S. P.].

Palo Alto Rancho, Altar Valley, ± 3000 feet, X, 10, 1910, (H.; small meadow in tall grass clumps), 1 ♂, (DEYdv 3).

Sentinel, X, 2, 1910, 686 feet, (R. & H.; under boards at night), 3 ♂, 4 ♀, (D to DE, Y, d and e, u but 1 ♀ v, 2 to 3; 1 ♂ 1 ♀ A, weakly reddish X, a and b, u 34)

Yuma, VII, 27, 1907 and X, 1, 1910, (R. & H.; at lights in streets), 22 ♂, 84 ♀,[59] (22 ♂ 81 ♀ weakly to very strongly B to a maximum condition in which the entire pronotum is pale, greatly suffused reddish Y to reddish Z, a to g, u but 1 ♂ w, 23 to 4; 3 ♀ EZeu 23).

British Columbia.

(G. W. Taylor), 1 ♀, (AWay 4), [Hebard Cln.].

Washington.

Yakima, (C. V. Piper), 1 ♀, 2 juv. ♀, (1 ♀ AVbv 3; juv. AV), [Hebard Cln.].

Oregon.

(Washburn), 3 ♂, 4 ♀, (3 ♂ 3 ♀ A, U to UV, a and d, u but 1 ♀ y, 23 to 4; 1 ♀ weakly B, yellowish Z, yellowish g, y 3), [Hebard Cln.].

Portland, VI, 19, 1882, 1 ♀, (AVW, weakly f, x 34), [Hebard Cln.].

California.

Amador County, 2 ♂, (AVXdv 01), [Am. Mus. Nat. Hist.].

El Portal, Mariposa County, 3200 feet, VIII, 30, 1907, (H.), 1 ♂, (AVXav 3).

Sacramento, VIII, 26, 1910, (R. & H.; at light in st

Los Angeles, VII, 1886, 1 ♂, 2 ♀, (A, VX and suffused reddish Z, dg and g. u. 23 and 4), [Hebard Cln.].

Pasadena, VI, 8, 1907, (F. Grinnell Jr.), 1 ♂, (AWXadv 3), [A. N. S. P.]; VIII, 1, 1907, 824 feet, (R. & H.), 1 ♂, (CZgv 23).

Santa Monica, VIII, 1, 1906, (F. Grinnell, Jr.), 1 juv. ♀, (B with abdominal segments suffused with buff, limbs all buff), [A. N. S. P.].

Avalon, Santa Catalina Island, VIII, 3, 1907, (H.; at light), 1 ♂, (AVXdu 3).

Claremont, (C. F. Baker), 1 ♂,[60] (AVbdv 3), [A. N. S. P.].

San Diego, VII, 28, 1901, (G. W. Dunn), 1 ♂,[61] (CYdu 023), [A. N. S. P.].

Coronado Beach, VIII, 17, 1907, (H.), 1 ♂, (AYdu 023).

Tia Juana, VIII, 16, 1907, (H.), 1 ♂, (CYdu 02).

Lyons, San Bernardino County, 2850 feet, VIII, 11, 1907, (H.), 1 ♂, (all reddish, reddish B, yellowish Z, du 3); IX, 1, 1909, (R. & H.; in bricks), 1 ♂, (AVXbu 23).

Palm Springs, VII, 13, 1897, (A. P. Morse), 1 ♂, *cotype* of *Gryllus vocalis* Scudder, (AXdu 2) [Hebard Cln.]; IX, 28 and 29, 1910, 450 feet, (R. & H.; young everywhere in house between sheets, blankets, etc., and very destructive), 2 ♂, 2 juv. ♂, (♂ A, WX and UX, adv, 3 and 4; juv. D with body and limbs yellowish.)

Tahquitz Cañon, San Jacinto Mountains, 500 to 1200 feet, IX, 30, 1910, (R. & H.), 1 juv. ♂, (B with abdominal segments outlined in buff, limbs all buff).

Fort Yuma at Colorado, 1 ♂, (BZdgu 03), [Hebard Cln.].

Mexico.

Torreon, Coahuila, X, 30 and XI, 4, 1909, (J. Friesser), 2 ♀, (1 ♀ AVau 3; 1 ♀ ABXdu 023), [Field Mus. Nat. Hist.].

San Miguel, Sonora, IV, 1892, (G. Eisen), 2 ♀, 1 juv. ♀, (AC, Y and Z, dg, u and y, 03 and 4), [Cal. Acad. Sci.].

Comondu, Lower California, III, 1889, (C. D. Haines), 1 ♂, 1 ♀, (♂ CZgu 02; ♀ A but mouth parts reddish, WXdgeu 02), [Hebard Cln.].

San Lazaro, L. Cal., IX, 1894, 1 ♀, (AC, reddish Z, ey 03), [Hebard Cln.].

San José del Cabo, L. Cal., (G. Eisen), 4 ♂, 21 ♀, 2 juv. ♂, 2 juv. ♀, (B to C, Y to Z, e and g, u, 012 to 03, but 1 ♂ A with mouth parts reddish, reddish Z, dy 01), [Cal. Acad. Sci.].

Mazatlan, Sinaloa, (from H. Edwards), 2 ♀, (1 ♀ A with reddish mouth parts, Xdu 03; 1 ♀ BCZey 03), [Am. Mus. Nat. Hist.].

Tepic, 1 ♂, 2 ♀, 1 juv. ♀, (1 ♀ 1 ♀ D, yellowish Z, a and b, y and u, 4 and 01; 1 ♀ ADVYbv 03), [Hebard Cln.].

Guadalajara, Jalisco, VIII, 21 to IX, 19, 1903, (J. F. McClendon) 11 ♂, 6 ♀;[62] (D. L. Crawford), 2 ♂, 6 ♀, (all A to C, VW to Z, d and e, u, 03 to 02), [all A. N. S. P.].

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[60] Recorded by Rehn as *Gryllus pennsylvanicus.*

[61] Recorded as *Gryllus assimilis* by Rehn.

[62] *Ibid.*

Zapotlanejo, Jal., VII, 31, 1903, (J. F. McClendon), 1 ♂,[63] (A, reddish Y, du 3), [A. N. S. P.].

Tuxpan, Jal., IX, 4, 1903, (J. F. McClendon), 1 ♀,[64] (D, suffused Z, fxy 3), [A. N. S. P.].

Aguascalientes, Aguascalientes, XI, 1887, (L. Bruner), 1 ♀, (AWdu 03), [Hebard Cln.].

Querétaro, Querétaro, XI, 1887, (L. Bruner), 1 ♀, (A with mouth parts pale reddish, Yeu 3), [Hebard Cln.].

Vera Cruz, Vera Cruz, I, 1892, 1 ♂, 1 ♀, (B, suffused Y, d and b, u, 03 and 023); (T. Heyde), 1 ♂, (B. suffused Y, du 03), [all Hebard Cln.].

Jalapa, V. C., V, 1 ♀, (DE, yellowish Z, dy 3), [Hebard Cln.]; VIII and IX, (O. W. Barrett), 1 ♂, 2 ♀,[65] (B and BC, suffused Z, d e and b, u, 012 to 01), [A. N. S. P.].

Teocelo, V. C., IX, (O. W. Barrett), 1 ♂,[66] (BC, suffused Y, du 012), [A. N. S. P.].

Cordoba, V. C., (H. de Saussure), 1 ♀, determined as *Gryllus mexicanus* Saussure by that author, (D, reddish yellow Z, by 3), [A. N. S. P.].

Orizaba, V. C., I and XI, 1892, 5 ♂, 15 ♀, 1 juv. ♀, (A B C and D, VW suffused Y and Y, a b d and e, w to u, 4 to 23), [Hebard Cln.].

Motzorongo, V. C., II, 1892 and V, 1893, 3 ♂, 2 ♀, (A to C, suffused Z, reddish Z V and W, v and u, 34 to 3), [Hebard Cln.].

San Rafael, V. C., (C. H. T. Townsend), 2 ♀, (D, suffused Z, cfy 3), [Hebard Cln.].

La Buena Ventura near Santa Rosa, V. C., VII, 1909, 2 ♀, (CDZeu 02), [Am. Mus. Nat. Hist.].

Chalchicomula, Puebla, II, 20, 1892, 1 ♀, (DZdy 23), [Hebard Cln.].

Distrito Féderal, VII, 1898, 1 ♂, 6 ♀, (A with mouth parts pale, reddish Z, du, 4 to 34), [Hebard Cln.].

Tacubaya, D. F., II, 1899, 1 ♀, (AWXdfu 34), [Hebard Cln.].

San Angel, D. F., VIII, 28, 1903, (W. L. Tower), 1 ♀, (A, buffy Y, bx 34), [Am. Mus. Nat. Hist.].

Yucatan, (Schott), 1 ♂, 1 ♀,[67] (AD, heavily suffused Z, du 02), [A. N. S. P.], (dried alcoholic).

Ticul, Yucatan, 1 juv. ♂, 1 juv. ♀,[68] (juv. ♂ E), [A. N. S. P.], (dried alcoholic).

Nicaragua.

II, 1893, (B. Shimek), 1 ♀, (A with mouth parts pale, UXdx 3), [Hebard Cln.].

San Ramon, Rio Wanks, V to VI, 1905, (W. S. Palmer), 1 ♂, (C, suffused Z, dx 03), [Hebard Cln.].

Costa Rica.

Caché, 1000 meters, V, 1905, (P. Biolley), 1 ♂, 1 ♀, (♂ AD, suffused reddish Y, dx 02; ♀ A with mouth parts pale, Vbu 02), [A. N. S. P.].

San José, II, 1903, (C. F. Underwood), 1 ♂, 2 ♀, (1 ♂ very strongly C, Z gu 02; 1 ♀ A with mouth parts pale, heavily suffused Y, bu 02; 1 ♀ weakly defined D, reddish Z, bxy 3), [Hebard Cln.].

Monte Redondo, Candelaria Mountains, III, 1902, (L. Bruner), 1 ♂, (B, suffused Y, dgw 034), [Hebard Cln.].

San Vicente, (J. F. Tristan), 1 ♂, 3 ♀, (B and weakly defined D, heavily suffused Y, d b and e, w and y, 3 to 4), [A. N. S. P.].

Tablazo, 1900 meters, VII, 1905 to IX, 1906, (P. Biolley), 4 ♂, 4 ♀, 1 juv. ♀, (AB and D, W reddish V and suffused Z, d and b, x and u, 4 to 03), [A. N. S. P.].

Pózo Azúl de Pirrís, (M. A. Carriker, Jr.), 3 ♂, 2 ♀, (AD and AB, suffused Y, d, u and x, 03 and 023), [Hebard Cln.].

Gulf of Nicoya, 5 ♀, (AB, heavily suffused Z, ab, u and w, 034 to 01), [Hebard Cln.].

Pacayas, 1430 meters, III, 1906, (P. Biolley), 2 ♂, 2 ♀, (B, reddish Y, dv 34), [A. N. S. P.].

Bermuda.

St. George Island, II, 23, 1909, (F. M. Jones), 1 ♀,[69] (AC, heavily suffused Z, bu 023), [A. N. S. P.].

Warwick Parish, IV, 11 to V, 9, 1909, (F. M. Jones), 7 ♂, 14 ♀,[70] (A to C, heavily suffused Z to Z, b and d to f, u to w, 45 to 023), [A. N. S. P.].

Paget West, XII, 14, 1908 to V, 9, 1909, (F. M. Jones), 10 ♂, 8 ♀,[71] (A to C, heavily suffused Z to Z, d to f, u to w, 5 to 023), [A. N. S. P.].

Somerset Island, Sandys Parish, II, 21, 1912, (M. Hebard), 1 juv. ♂, (CV), [Hebard Cln.].

[67] Recorded as *Gryllus barretti* by Rehn.
[68] Recorded as *Gryllodes toltecus* by Rehn.
[69] Recorded as *Gryllus bermudensis* by Rehn.
[70] *Ibid.*
[71] *Ibid.*

Bahamas.

Grant Town, New Providence Island, II, 3, 1904, (M. Hebard), 1 ♂, 2 ♀,[72] (strongly C, Zdu 023), [Hebard Cln.].

Cuba.

Vinales, Pinar del Rio, IX, 16 to 22, 1913, (Lutz and Leng), 2 ♀, (DZdu, 03 and 01), [Am. Mus. Nat. Hist.].

El Guama, Pinar del Rio, (Palmer and Riley), 2 ♀, (C and D. Z, d and g, u, 3 and 03), [A. N. S. P.].

Guanajay, Pinar del Rio, V, 6, (Palmer and Riley), 1 ♀,[73] (CD, suffused Z, du 01), [A. N. S. P.].

Havana, I, 1904, (M. Hebard), 1 ♀,[74] (strongly D, Zey 03), [Hebard Cln.].

Francisco, Camaguey, (Mrs. J. S. Durham), 1 ♂, 1 ♀, (C, Z and suffused Z, ad and ab, u 02), [A. N. S. P.].

Santiago, XII, 11, 1903, 2 ♂,[75] (C, suffused Z, du, 02 and 01), [A. N. S. P.].

San Carlos Estate, Guantanamo, X, 4 to 8, 1913, (F. E. Lutz), 3 ♂, 1 ♀, (CZ, d and B, u 012), [Am. Mus. Nat. Hist.].

Porto Rico.

Mayaguez, II, 15 to 16 and VII, 24 to 29, 1914, 2 ♀, (AD, suffused Z, bu, 012 and 01), [Am. Mus. Nat. Hist.].

Ponce, VII, 20 to 22, 1914, 1 ♀, (DZbu 02), [Am. Mus. Nat. Hist.].

Jamaica.

Montego Bay, X, 29 to XI, 2, 1913, (M. Hebard), 1 ♀, 1 juv. ♀; XI, 1913 to III, 1914, (C. G. Hussey; 1 at light), 3 ♀, (all C, suffused Y to Z, b to g, u 012), [all Hebard Cln.].

Halton, Barbados, X, 25, 1902, (C. Todd), 1 ♂, 2 ♀,[78] (C and B, Z, d and e, u, 34 to 03), [A. N. S. P.].

Colombia.

Cincinnati Plantation near Santa Marta, 4000 to 5000 feet, VII, 9 and 10, 1913, (M. A. Carriker Jr.), 1 ♂, (A, buffy VW, au 02), [Hebard Cln.].

Trinidad.

Caparo, VI and VIII, 1913, (S. M. Klages), 7 ♂, 9 ♀, (BC to C, greatly suffused Z to Z, d a and b, u, 023 to 012), [A. N. S. P. and Hebard Cln.].

British Guiana.

Bartica, IV, 4, 1901, (R. J. Crew), 1 ♂, (A, greatly suffused Y, dx 02); (H. S. Parish), 1 ♂, (AC, greatly suffused Y, du 02), [all A. N. S. P.].

Brazil.

Pará, Pará, (C. F. Baker), 1 ♂, 1 ♀, (C, Z and suffused Z, weakly f and b, u 02), [A. N. S. P.].

Igarapé Assu, Pará, (H. S. Parish), 2 ♀, (A with mouth parts pale, weakly reddish W, intense b, u 023), [A. N. S. P.].

Tijuca, Rio de Janeiro, IV, 9 to 11, 1913, (M. Burr), 1 ♀, (ADW, strongly b, u 03), [A. N. S. P.].

Rio Grande do Sul, (Dr. Ihering), 1 ♂, determined as *Gryllus argentinus* Saussure by that author, (AWgv 023), [A. N. S. P.].

Paraguay.

Sapucay, II, 17 to VII, 1902 and 1905, (W. T. Foster), 3 ♂, 5 ♀,[79] (1 ♂ 1 ♀ FZgu 023; 1 ♀ DZgu 02; 2 ♂ 1 ♀ A with mouth parts weakly reddish, W and X, d and b, ♂ v ♀ u, 023 to 02; 2 ♀ weakly and strongly C, suffused reddish Y and suffused reddish z, ev, 03 and 02), [Hebard Cln.].

Argentina.

Misiones, XII, 30 and I, 1910 and 1911, (P. Jorgensen), 2 ♀,[80] (1 ♀ A with reddish mouth parts suffused reddish Z, eu 03; 1 ♀ AVbu 02), [A. N. S. P.].

Salta, Salta, 1 ♂, 1 ♀, (weakly C, V and WY, d and b, u, 02 and 01), [A. N. S. P.].

Jujuy, Jujuy, IV, 1911, (P. Jorgensen), 1 ♀, (AUVbu 02), [A. N. S. P.].

Buenos Aires, (M. G. Claraz), 1 ♀, *cotype* of *Gryllus argentinus* Saussure (AVXcu 012), [A. N. S. P.].

[78] Recorded by Rehn as *Gryllus assimilis*.

[79] Recorded as *Gryllus assimilis* and *argentinus* by Rehn.

[80] Recorded by Rehn as *Gryllus argentinus*.

La Combre, Cordoba, (C. Lizer), 2 ♀, (1 ♀ AXdw 03; 1 ♀ AVXew 012), [A. N. S. P.].

Chacras de Coria, Mendoza, 936 meters, (P. Jorgensen), 1 ♂, 3 ♀,[81] (1 ♂ A with mouth parts reddish, dark reddish Z, gw 023; 1 ♀ AX, intense f, w 02; 2 ♀ AVXfw 023), [A. N. S. P.].

Mendoza, Mendoza, 767 meters, (P. Jorgensen), 1 ♂,[82] (AUVbu 02), [A. N. S. P.].

Galapagos Islands.

Chatham Island, 1 juv. ♂, 1 juv. ♀, (greatly suffused Z), [Hebard Cln.], (dried alcoholic).

Ecuador.

Duran, VI, 14 to 24, 1914, (H. S. Parish), 5 ♂, 7 ♀, (C to D with color pattern further defined by longitudinal median occipital lines, greatly suffused Z to Y and Z, d and b, u, 023 to 012), [A. N. S. P.].

Peru.

Contamano, Rio Ucayali, X to XII, 1912, 2 ♀, (1 ♀ A with mouth parts reddish, VX, intense C, u 02; 1 ♀ C, reddish Z, dfu 02), [A. N. S. P.].

Chanchamayo, 1 ♂, 1 ♀, (A with mouth parts reddish, dark reddish Z and V, d and b, v and u, 02), [A. N. S. P.].

Lima, VIII, 19, 1914, (H. S. Parish), 1 ♂, (pale D, Zdx 02), [A. N. S. P.].

Chile.

Rancagua, O'Higgins, XI, 1903, (C. S. Reed), 5 ♂, 3 ♀, (A, W to deep reddish Z, dg and weakly f, v, 03 to 012), [A. N. S. P.].

Rengo, Colchagua, XII, 1903, (C. S. Reed), 3 ♂, 2 ♀, 2 juv. ♀, (A, V to suffused Z and reddish Z, d f and g, u to x, 03 to 02), [A. N. S. P.].

Concepcion, XI, 1903, (C. S. Reed), 1 ♂, 2 ♀, (A, suffused reddish Z, g and fg, v, 03 and 02), [A. N. S. P.].

Gultso, XI, 1903, (C. S. Reed), 1 ♂, 1 ♀, (A, X and V, dg and f

sides; below the ventro-lateral margins of this portion on each side, rests a somewhat more thickened, narrow, corneous plate which is exteriorly nearly horizontal at the base, but produced and upcurved with blunt apex reaching a little distad of the apex of the dorsal portion, inside at the juncture with the dorsal portion this ventro-lateral portion is strongly concave thus forming claw-like projections which hold in the seminal sac without pressing upon it at any point. (See Plate IV, figs. 11 and 12.)

The species has been accidentally introduced by man from Europe and is now widely distributed through temperate North America. It has in the past been recorded from Montreal, Quebec; Connecticut; New York, New York; New Brunswick, New Jersey; Ohio; Lexington, Kentucky; West Terre Haute, Indianapolis and Putnam County, Indiana; Moline and Urbana, Illinois; Minnesota, and Omaha, Nebraska.

The insect inhabits dwellings, greenhouses, etc., where it is sometimes found in large numbers. The species is decidedly more alert and active than *assimilis*, in its movements more nearly resembling the extremely rapid *Gryllodes sigillatus*, which tropical species also appears to prefer the proximity of man.

The series recorded below are in general coloration yellowish brown, the specimens from Chicago, Illinois, and Albany, Georgia, are slightly darker than normal with caudal femora weakly suffused.

Specimens Examined: 27; 7 males, 14 females, 2 immature males and 4 immature females.

West Farms, New York, 1 ♀, [U. S. N. M.].

Harrisburg, Pennsylvania, XI, 18, 1 juv. ♂, [Pa. State Dept. Zool.].

Philadelphia, Pa., IX, 30, 1914, (E. R. Casey; on Logan Square), 1 ♀, [Casey Cln.].

West Philadelphia, Pa., IX, 14 and 16, 1901, (W. Stone; in house), 3 ♂, 2 ♀, 3 juv. ♀, [A. N. S. P.].

Carolina, 1 ♀, [U. S. N. M.].

Roswell, Georgia, (King), 1 ♂, [U. S. N. M.].

Albany, Ga., VIII, 1, 1913, (H.: under sign on oak tree), 1 juv. ♀.

Thomasville, Ga., IV, 1901, (H.; in house on lamp shade at night), 1 ♀.

Utaw, Alabama, 2 ♀, [U. S. N. M.].

Chicago, Illinois, (W. J. Baumgartner; in greenhouse), 1 ♂, 1 ♀, [A. N. S. P.].

St. Anthony Park, Minnesota, IX, 9, 1896, (O. Lugger), 1 ♀, [Hebard Cln.].

Lincoln, Nebraska, 1 ♀; V, 18, 1901, (M. Cary; at light), 1 ♀, [both Hebard Cln.].

San Antonio, Texas, 1885, (M. Newell), 2 ♀, [Hebard Cln.].

Laredo, Tex., VIII, 12, 1912, (H.; very common in town and exceedingly active, always in inaccessible holes and dark places in stores, walls, etc.), 2 ♂, 1 juv. ♂.

Plate IV.

The outlines are very greatly enlarged, the stipple figures over twice natural size.

1. *Gryllus assimilis* (Fabricius), *assimilis* variant. Tia Juana, California. Male. Dorsal view of head.
2. *Gryllus assimilis* (Fabricius), *personatus* variant. Tucson, Arizona. Male. Dorsal view of head.
3. *Gryllus domesticus* Linnæus. San Antonio, Texas. Female. Dorsal view of head.
4. *Gryllus assimilis* (Fabricius), *mexicanus* variant. Chalchicomula, Mexico. Facial aspect.
5. *Gryllus assimilis* (Fabricius), *personatus* variant. Sentinel, Arizona. Male. Facial aspect.
6. *Gryllus assimilis* (Fabricius), *personatus* variant. Tucson, Arizona. Female. Facial aspect.
7. *Gryllus assimilis* (Fabricius), *personatus* variant. Tucson, Arizona. Male. Facial aspect.
8. *Gryllus assimilis* (Fabricius), *pennsylvanicus* variant. Raleigh, North Carolina. Lateral outline of male titillatores.
9. *Gryllus assimilis* (Fabricius), *pennsylvanicus* variant. Raleigh, North Carolina. Ventral outline of male titillatores.
10. *Gryllus domesticus* Linnæus. San Antonio, Texas. Female. Facial aspect.
11. *Gryllus domesticus* Linnæus. Philadelphia, Pennsylvania. Lateral outline of male titillatores.
12. *Gryllus domesticus* Linnæus. Philadelphia, Pennsylvania. Ventral outline of male titillatores.

The similarity between the *mexicanus* variant and darkest examples of the *personatus* variant are shown by figs. 4 and 5. In the *personatus* variant every condition between figs. 5 and 7 is found in the material before us, though the great majority of specimens show the strongly defined color pattern.

The male titillatores are, in all the variants of *assimilis*, as shown in figs. 8 and 9.

MOLLUSCA OF THE SOUTHWESTERN STATES, VI: THE HACHETA GRANDE, FLORIDA, AND PELONCILLO MOUNTAINS, NEW MEXICO.

BY HENRY A. PILSBRY.

I. THE BIG HACHET MOUNTAINS.

The Big Hachet (or Hacheta Grande) Mountains are a short range in southern New Mexico in sight of the Mexican boundary.

They may be reached from the station of Hachita, on the El Paso and Southwestern R. R., where provisions can be obtained. Water must be hauled in, unless the prospecting in progress at the time of our visit resulted in a successful well. There are no trails in the mountains. The extreme northern end of the range remains to be worked conchologically, as we could not reach it from our camp. A visit should be planned much earlier or later than ours (August), in order to have the advantage of what rain there is and also to avoid the excessive heat.

The highest peak, Hacheta Grande, has an elevation of about 8,500 ft., and is considerably higher than any other in the group. Several large canyons dissect the range, two of them forming broad basins.

There are no springs in the range, but sometimes after the infrequent rains a little water remains for a time in rocky basins in narrow canyons. We found one such hole containing about half a barrel. It was foul with drowned insects, yet most welcome, as our canteens were dry, towards the end of a two-day trip to Big Hachet Mountain.

The colonies of snails here as in other desert mountains are usually of small area. As the mountains are uninhabited and too dry for cattle ranges, there are few local place names and no roads or ranches to aid in locating collecting points. In the absence of any topographic map, we reproduce a rough map made from our field notes, which should enable anyone to exactly locate nearly every colony of snails found. For convenient reference we have named several prominent landmarks, such as Daniels Mountain,[1] the highest peak northward as seen from Sheridan Canyon, and Teocalli Butte, west of our camp, both being inhabited by special races of snails.

[1] Named for the writer's companion on this somewhat arduous trip.

The Big Hachets are without timber. Only the higher peaks are in the pinyon zone. There are some scrubby cedars and old gnarled pinyon pines, nowhere numerous. On some of the higher slopes of Hacheta Grande Mt. there is a growth of very small scrub oak, sometimes so close as to impede travel, as it is mingled with a broad-leaved, black-spined agave. Elsewhere a small agave with white filaments is very abundant. There is also an agave zone surrounding the mountains, bounded outwardly by the zone of giant yuccas, both usual on the slopes leading to the mountains in this part of New Mexico. South of Daniels Peak the higher hills and buttes usually have *Fouquieria* and its characteristic society. The rock is hard limestone worn into holes and points, and containing few ill-preserved fossils, among which a *Zaphrentis*-like coral, crinoid stems and a spiral univalve are most abundant. Rattlesnakes, large centipedes, tarantulas and small brown scorpions are reasonably abundant. Birds and mammals are scarce, and owing to the absence of springs, the mountains are not available for cattle range. During the time we were there (August 20 to 26, 1910) the heat was intense from sunrise until after 9 P.M. Sky cloudless until midday, when small clouds gather, possibly covering 10 p. c. of the sky. There was very little wind. The annual rainfall is not known, but must be less than 9 or 10 inches, recorded from the region immediately northward.

Previous to the visit of Mr. L. E. Daniels and the writer, in August, 1910, the mollusks of these mountains had been collected by Dr. Edgar A. Mearns, U. S. A., while serving on the survey of the Mexican boundary.

Dr. Mearns started from Mesquite or Mosquito Springs, Chihuahua, 6 or 8 miles east of the mouth of Sheridan

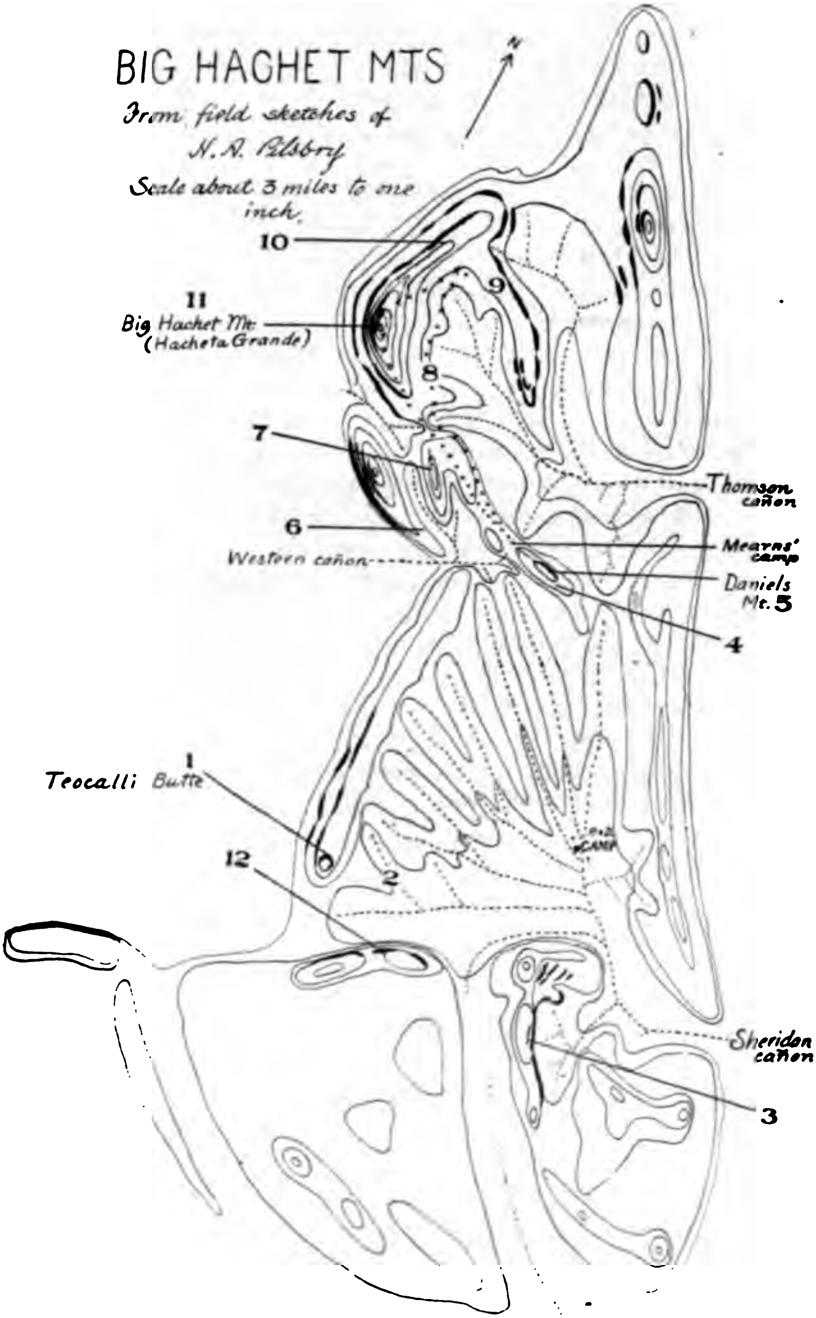


Fig. 1.—Sketch of the Big Hachet Range, showing collecting stations.

Dr. Mearns returned to Mesquite Springs along the ridge running from Daniels Mt. towards our camp in Sheridan Canyon, and along the wash running out of this canyon.

Dr. Mearns found the following seven species, which were determined by Dr. Wm. H. Dall:[3]

Patula strigosa Gould, var. *concentrata* Dall. [Specimens reported from summit of Hacheta Grande=*Oreohelix hachetana*.]

Epiphragmophora hachitana Dall [=*Sonorella hachitana*].

Polygyra mearnsii Dall [=*Ashmunella mearnsi*].

Thysanophora hornii Gabb.

Holospira crossei Dall.

Holospira bilamellata Dall.

Holospira mearnsi Dall.

The relationships of the Big Hachet fauna are closest with the Florida and Organ ranges. Near related species of *Sonorella* and *Ashmunella* inhabit these three ranges, and *Sonorellas* very close to *hachitana* have been found in the Carrazolillo and Peloncillo Mountains. The Oreohelices stand nearest to Chiricahua species. The *Holospiras* and *Vallonia* are special to the range, but the other small shells are common to most mountains of southern Arizona.

Holospira is the most generally distributed snail in these mountains. Its abstemious nature is evidently satisfied with the scanty moisture supplied by the rare rains and light snow, which is said to whiten the mountains for brief periods in the winter. No doubt a great many colonies and other local races of *Holospira* remain to be found.

Holospira lives only where there is limestone. We never found but one colony on igneous rock, and this was on a dyke in a limestone

are oviparous—a further character distinguishing them from *Oreohelix*, which is viviparous. It is also a more primitive feature.

Sonorella hachitana (Dall). Plate V, figs. 4, 4*a*, 4*b*.

> *Epiphragmophora hachitana* Dall, Proc. U. S. Nat. Mus., XVIII, p. 2, 1895; XIX, p. 338, 1896.
> *Sonorella hachitana* (Dall), Pilsbry, Proc. A. N. S. Phila. for 1900, p. 556, 1901; 1905, p. 257 (in part).
> *Sonorella hachitana* (Dall), Bartsch, Smithsonian Misc. Coll., vol. 47, p. 190, Pl. 31, fig. 2 (shell of type); Pl. 29 (apex), 1904.

As this species is type of the genus *Sonorella*,[5] the investigation of its soft anatomy had become a matter of importance, and to obtain living material was one of the chief objects of our quest in the Hachetas.

We found it at Stations 7, 8, 10 and 11. All of these stations are near or on Dr. Mearns's route to the summit of Hacheta Grande. Station 7, on the western slope of a hill at the head of the northern branch of Western Canyon, was the most prolific locality. Here the Sonorellas may be found in some numbers under large stones on the steep slope near the hill-top, where there is some shade from the piñon pines.

Twenty-one adult shells from this station measure as follows:

Diam. in mm	21.5	22	22.5	23	23.5	24
Number of shells	2	8	2	7	1	1

The shells vary somewhat in the degree of deflection of the last whorl, but very little in other respects. The last whorl descends more than in most related species. The color is pale fawn, fading to whitish in the middle of the base, and having a cinnamon-brown, shading into chestnut-brown, band above the periphery; this band is bordered with white on both sides. The aperture is rather small, its greatest diameter (including peristome) being 50 to 54 per cent. of the diameter of the shell.

At Station 8 only dead shells were found, but these are more variable in size, the extremes in a lot of 8 measuring:

Alt. 13.5, diam. 25.5 mm.; aperture diam. 13.6 mm.
" 11 " 21.3 " " " 10.8 "

---

[5] *Epiphragmophora hachitana* Dall was originally designated as the type of *Sonorella*, but the soft anatomy of the genus was described from New Mexican specimens of what was subsequently determined as a small form of *S. ashumni* Bartsch, a species which at that time had not been discriminated from *S. hachitana*. The dissection of topotypes of *hachitana* shows that the New Mexican form is specifically distinct, though closely allied.

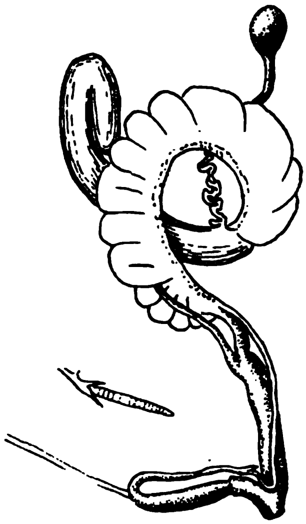


Fig. 2.—Genitalia of *S. hachitana*, with detail of penis-papilla.

At Station 5 two broken examples, much weathered, were dug out of the soil. Though practically adult, the largest measures only 18.2 mm. diameter, the shell being quite as solid as in large individuals. It was probably dwarfed by the arid conditions before it became extinct in this place.

The genitalia are remarkable for the small size of the male organs. The penis is very slender, diameter 1 mm., tapering downward, and encircled at the base by a short sheath. The penis-papilla is very slender, gradually tapering, and annulate. The retractor muscle is terminal, long and slender. Epiphallus a little shorter than the penis. The vagina is slightly longer than the penis. Other organs as usual. Measurements of the organs of two individuals are given in the following table, with those of allied forms for comparison.

	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.	Penis retractor.	Museum No.

anatomical characters, which, though not great, seem to be constant in a considerable number examined, and which favor the more analytical treatment of the *hachitana* group effected by Dr. Bartsch, —a view I formerly opposed. After examining many fresh specimens from both ranges, I separate the Florida and Hacheta Sonorellas subspecifically.

Whether the typical form of *S. hachitana* occurs outside of the Big Hachet range is doubtful. The Peloncillo range *Sonorella* (*S. h. peloncillensis*) is not easily distinguishable by the shell alone, but the proportions of the genitalia differ.

On the Carrizolillo Mts., top of two peaks near the boundary line, numerous "bones" were collected by Dr. Mearns (No. 126,596, U. S. N. M.). They agree with *S. hachitana* in the rather wide umbilicus, small aperture and deeply descending last whorl, but differ by the average smaller size, from alt. 10.8, diam. 19.3 mm., to alt. 12.4, diam. 21.4 mm. It is apparently a small race of *hachitana*. The locality is about 30 miles east of Big Hachet Mountain.

Specimens reported as *S. hachitana* from the Chiricahua Mountains will doubtless turn out to be one of the species already described from there. Several resemble *hachitana* more or less in the shell, but all differ in genitalia.

The specimen reported from the Santa Rita Mountains (No. 105,385, U. S. N. M.) is dead and broken. It is not *hachitana*, but probably an undescribed species near *S. clappi* P. & F.

Ashmunella mearnsii (Dall). Plate V, figs. 1 to 16.

Polygyra mearnsii Dall, Proc. U. S. Nat. Mus., XVIII, p. 2, 1895; XIX, p. 343, Pl. 32, figs. 7, 8, 11, 1896.

Up to this time *A. mearnsii* has been known from the original lot collected by Dr. Mearns about twenty years ago.[6] We found it

[6] The figured type of *A. mearnsii* and nine specimens in various conditions of perfection are Cat. No. 130,012, U. S. N. M., said to be from the Huachuca Mts. In the adult shells of this lot the parietal wall of the aperture is built up and disjoined from the preceding whorl. In another lot, No. 130,013, U. S. N. M., three specimens, Hacheta Grande Mt., the parietal callus is appressed. This difference in the parietal callus is exactly what we have noticed between the specimens from our Station 5 (near Dr. Mearns's camp site) and those from our Stations 10 and 11, near and at the top of Hacheta Grande Mt., a place also visited by Dr. Mearns. We conclude, therefore, that there was a mistake of "Huachuca" for "Hacheta" in the label of No. 130,012; and that *A. mearnsii does not really live in the Huachucas.* This seems the more likely because in several camping trips to the Huachucas this species was not found.

A record of *A. mearnsi* from the Organ Mountains, N. M., has been published, on the authority of Professor Cockerell. We have not seen the specimen, but suspect that they are *A. kochi* Clapp.

We suggest that our Station 5 in the Hacheta Mountains be accepted as type locality for *A. mearnsi*.

in great profusion at Station 5 on the east side of Daniels Mountain, near the summit, with *Holospira bilamellata*. Also at Stations 7, 10 and 11, the latter at the summit of Hacheta Grande.

The specimens from Station 5 (not far from the site of Dr. Mearns's camp) agree well with the original specimens, description and figure. Usually the parietal callus is raised from the surface as a thin, straight lamina, and in almost all of them the edge is more definite than in shells from other stations. The axial end of the parietal lamella is abruptly bent towards the columella and is more or less tubercular: Rarely the tubercle is almost free from the lamella. The spire is occasionally almost flat. The color in shells taken alive is translucent sayal brown. The diameter varies from 11.5 to 14.5 mm.

In specimens from the summit of Hacheta Grande the parietal lamellæ are a little shorter; the axial end of the longer branch is often straight, but more frequently is bent, or the bend is represented by a tubercle connected with, or almost free from the lamella. The edge of the parietal callus is appressed to the surface, and is often arcuate. The aperture varies in obliquity, as the figures show.

The penis is stout, bipartite. The epiphallus is strongly convoluted just beyond the insertion of the retractor muscle. It is very long. No flagellum seen.

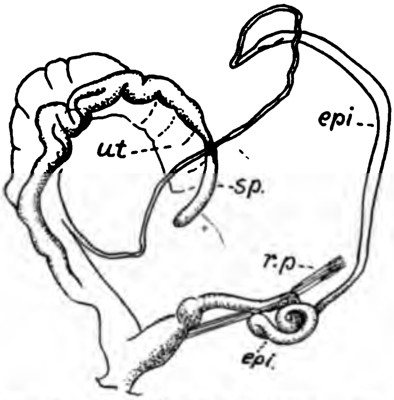


Fig. 3.—Genitalia of *A. mearnsi*. *epi.*, epiphallus; *p.*, penis; *r.p.*, retractor

mon-drab to pale ecru-drab, often having a band of the same below the periphery; embryonic whorls fawn color. Spire convex or very low conic, 1¾ embryonic whorls convex, sculptured with delicate, retractive radial rib-striæ, a few very fine spiral lines in the intervals (fig. 6); following whorls irregularly marked with weak growth-lines, less convex, a little flattened or impressed above the suture, the last whorl convex, very indistinctly angular at the periphery, slowly descending to the aperture, convex beneath. The aperture is very oblique, about as high as wide. Peristome thin, the upper and basal margins somewhat prolonged and a little straightened, converging, joined by a thin, adnate parietal callus.

Alt. 9, diam. 15 mm.; 5¼ whorls.

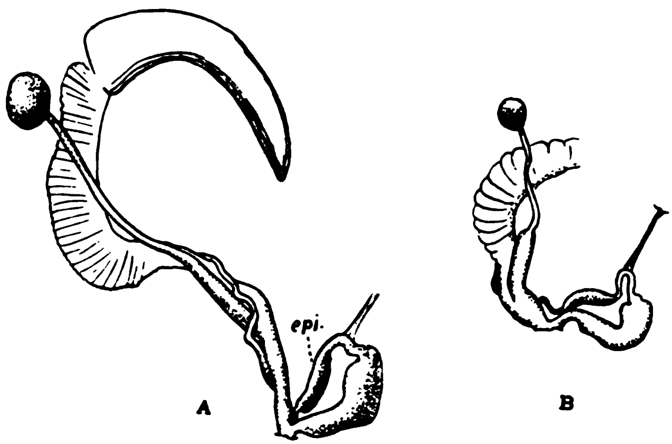


Fig. 4.—A. Genitalia of *Oreohelix hachetana*. B, *Oreohelix ferrissi*.

Genitalia (fig. 4,A). The penis is very short, its distal half enlarged. The walls of the rather large cavity are densely papillose, the papillæ long, arranged in oblique rows in some parts. Epiphallus about equal in length to the penis, its distal half enlarged. Vagina equal to the penis in length. Length of the penis, epiphallus and vagina 5 mm.; length of spermatheca and duct 15 mm.

Summit of Hacheta Grande Mountain, at Station 11, collected August 25th, 1910, by H. A. Pilsbry. Also Station 10, Pilsbry and Daniels.

This species was collected in considerable quantity—several hundred living specimens. The "bones" are seen all over the upper four or five hundred feet of the peak, between Stations 10 and 11 of the map. Living snails were all taken on the west side and were most

abundant at the summit near and north of the small stone "monument" or cairn which marks the summit, on and under stones. Also on the precipitous western slope at Station 10.

The species is very uniform in all its characters. The size varies from 14 to 16 mm. diameter, and in some shells the last whorl descends more than in others. Very few have the parietal callus thickened and a little raised. It differs from all forms of *O. strigosa* by its convex, radially costellate embryonic whorls, but in many adult shells this sculpture is effaced. *O. ferrissi* is probably the most nearly related species, though very different.

Oreohelix hachetana cadaver n. subsp. Plate VI, fig. 2.

The shell is larger than *hachetana*, the periphery rounded in adults except near the aperture in front, where it is distinctly angular. Umbilicus smaller, one-sixth the diameter of the shell.

Alt. 11.5, diam. 18.5 mm.; barely 5 whorls.

Station 5, below the cliffs on the north side of the summit of Daniels Mountain, Daniels and Pilsbry, August 22d, 1910.

Only a few long-dead shells were found in this thirsty place, where, at the base of the cliffs there are a few small pinyon pines, mostly dead or moribund. *Holospira* and *Ashmunella mearnsi* live here in abundance.

A young shell, long dead, found at Station 6, may belong to the same variety.

Oreohelix (Radiocentrum) ferrissi n. sp. Plate VI, figs. 4 to 5*d*.

The shell is openly umbilicate, umbilicus conic, over one-fourth the total diameter; slightly convex above, base strongly convex; thin, light dull brown. The embryonic shell of $1\frac{1}{2}$ convex whorls is finely lamellose striate radially (fig. 5*d*). Post-embryonic whorls

Genitalia similar to *O. hachetana*, except that the lower third of the duct of the spermatheca is more enlarged. Length of penis 5 mm.; epiphallus 5.5 mm.; spermatheca and duct 9 mm. (fig. 4 B).

Hacheta Grande Mts. at Station 3, on ledges of high cliffs opposite the mouth of Sheridan Canyon, under stones, Pilsbry and Daniels, August 21, 1910. Cotypes. No. 112,276, A. N. S. P. Also at Station 1, Teocalli Butte.

O. ferrissi has much the appearance of the Chiricahuan *O. barbata* Pils., but this resemblance is superficial. When denuded of the cuticular fringes, the two are quite different, the Chiricahuan species being much smoother, without the strong spiral ridges of *O. ferrissi*. Moreover, the sculpture of the embryonic shell is different. The shape of penis and epiphallus in *O. ferrissi* is like *O. chiricahuana* and *O. clappi*, both organs being enlarged distally, while in *O. barbata* the lower half of the penis is enlarged, the distal portion slender.

In well-developed shells the last whorl scarcely descends anteriorly, the upper margin of the lip being inserted on the peripheral carina. In some of the smaller adults, diam. 13 mm., the last whorl is bent downwards: the upper and columellar margins of the lip converge and are connected by a raised parietal lamina, the mouth having a somewhat triangular contour. These are to be regarded as decadent (gerontic) individuals.

At Station 1, Teocalli Butte, the shells are all convex above, with a noticeably smaller umbilicus. The largest measures, alt. 7.8, diam. 15 mm., with 5 whorls (Pl. VI, fig. 4*b*). This small colony is probably extinct or nearly so, as no living shells were found.

Our Station 3 is on ledges of high cliffs facing the mouth of Sheridan Canyon, and especially on a bench about half-way up. Here Ferriss's *Oreohelix* lives on an almost inaccessible cliff looking out over the mesa into Mexico. There is little vegetation on the ledges. On the talus slope below the cliff there is a growth of dwarf oak about knee-high, charming big wild roses of a species which we saw nowhere else, *Cylindropuntia*, *Opuntia*, bisnagas, etc. On top, above the cliffs, the *Fouquieria*, sotol, mescal society is found. The *Oreohelix* colony is of small extent; the ledges where they were observed living are probably not over a couple of square rods in area, with perhaps an equal area on the talus below the cliffs, where dead shells were found. These estimates are from memory, as I neglected to note the figures at the time.

The locality on the east side of Teocalli Butte is more restricted, and if possible more arid.

Oreohelix ferrissi mortioina n. subsp Plate VI, fig. 3.

Differs from *O. ferrissi* by the more convex spire and by the weakness of the spiral sculpture, there being no such pronounced spiral ridge on the upper surface of the whorls, and only very weakly sketched spirals on the base, whilst in *O. ferrissi* these ridges are very emphatic.

Alt. 7.2, diam. 14.2 mm.; $4\frac{3}{4}$ whorls.

Station 5, below the cliffs on the north side of Daniels Mountain, near the summit, with *Holospira*, etc.

Only a few long-dead shells were taken, but these surely indicate a local race which has finally succumbed to the increasing aridity of their station. Of large shells only *Holospira* and *Ashmunella* survive on this mountain, both of them being burrowing animals.

Thysanophora hornii (Gabb).

Found at Stations 3 and 5. It is an almost ubiquitous Lower Sonoran snail.

UROCOPTIDÆ.

The study of a very large series of Hachita Holospiras has fully confirmed the results reached in our study of Chiricahuan species, that the number of internal lamellæ is variable in each species and colony, among perfectly mature or even aged individuals. They vary in a way it was impossible to foresee at the time when Holospiras were so rare that only one or two of a lot could be opened. Very naturally, the number of internal lamellæ was thought at that time to be of specific and even subgeneric value.

In some colonies it appears that the largest shells have in the average the greatest development of lamellæ, so that it might be thought that only the most vigorous individuals attain the full

almost every form known by large lots) may be (1) *Superior, axial and basal*, or (2) *axial only*. In Hachita forms we have also the combination (3) *axial and basal*, which is never found in the Chiricahuan series, where it is replaced by the combination (4) *superior and axial*. Every Hachita species has, therefore, in different specimens of the same colony, the characters of the supposed subgenera or sections *Bostrichocentrum*, *Haplostemma*, *Distomospira*, and *Tristemma*, while a Chiricahuan species will belong to *Bostrichocentrum*, *Eudistemma*, and *Tristemma*. In external form and sculpture there are no differences greater than specific between the Hachita and Chiricahua species.

The Hachita Holospiras belong, if we accept the criterion of intergradation, to only one species, for which the prior name is *H. crossei*. Between this species and *H. bilamellata* there is a perfect series of intergrades in size, sculpture and number of whorls. We mean by this that some individuals of an *H. crossei* colony could not be distinguished from *mearnsi;* some *mearnsi* can be exactly matched in a colony of *bilamellata*, or of *media;* and certain slender shells of *bilamellata* would pass as *longa*. The other named forms are more distinct, probably because we did not happen to collect where the intergrading colonies live. The races are therefore based upon the forms dominant in each colony. One might easily define a half dozen *species*, if only a few shells from each place were in hand; or if the internal lamellæ were taken to be of specific weight, it might be thought that there are between two and three times that number.

There are many colonies, most of which have some special characters. A thorough exploration of the northern end of the range will undoubtedly bring to light very many more forms, so that any treatment of the group must now be tentative. For our present purpose we consider the smallest form (*crossei*) and the largest (*bilamellata*) as species, ranking the others as subspecies, though in some cases they are more distinct than these two are from one another. Several thousand shells were collected.

The colonies at Stations 1, 2, 3, 12, are of very limited extent, physical features restricting them. Station 5 is much larger. The other Stations, 4, 6, 8, 9, 10, 11, merely represent collecting points in large areas where *Holospira* may be picked up almost anywhere over considerable tracts, while at the same time there are large areas in the region over which these stations are scattered where no shells can be found.

Holospira bilamellata Dall. Plate VII, figs. 1 to 1*d*.

Holospira (*Distomospira*) *bilamellata* Dall., Proc. U. S. Nat. Mus., XVIII, 1895, p. 4; XIX, p. 896, p. 349, Pl. 31, fig. 3. Pilsbry, Man. of Conch., XV, 1902, p. 82, Pl. 16, figs. 5, 10, 11. Bartsch, Proc. U. S. Nat. Mus. XXXI, 1906, p. 134. Daniels, Nautilus, XXVI, p. 41, Pl. 5, fig. 9 (normal) and fig. 8 (abnormal) shells.

The first four references cited above pertain to specimens of the original lot, of which there are 8 perfect shells in Coll. U. S. Nat. Mus. and 2 in Coll. A. N. S. Phila.

The species is distinguished from *H. crossei* chiefly by its greater size. It was found by Mr. Daniels and the writer in great abundance at Station 5, on the east side of Daniels Mountain under the cliffs close to the summit, with *Ashmunella mearnsi* and *Oreohelix*, in the piñon zone. In most of the shells the external ribs weaken or disappear on the penultimate and one or two earlier whorls, but in some they continue to the last, as in the type lot of *bilamellata*.

Sixty examples from Station 5 opened, most of them measured give the following data:

(1) One lamella, the axial. 13 specimens = 21⅔%.

Length	23,	diam.	5	mm.;	whorls	19
"	21.3	"	4.7	"	"	18½
"	19.5	"	5	"	"	16½
"	19	"	4.7	"	"	17
"	18	"	5	"	"	16
"	18	"	5	"	"	16
"	17.7	"	4.3	"	"	15½
"	17.2	"	4.5	"	"	16
"	16	"	4.5	"	"	14½
"	14.3	"	4.5	"	"	13

(2) Two lamellæ, axial and basal. 41 specimens = 68⅓%.

Length	18,	diam.	5	mm.;	whorls	16
"	17.7	"	4.8	"	"	16
"	17.5	"	4.2	"	"	15
"	17.2	"	5	"	"	15½
"	17	"	4.8	"	"	15½
"	16.8	"	4.8	"	"	15⅓
"	16.5	"	4.4	"	"	14½
"	16.3	"	4.6	"	"	15
"	16	"	5.5	"	"	13½
"	16	"	4.5	"	"	14½
"	16	"	4.5	"	"	15
"	15.5	"	4.5	"	"	14⅓
"	15.2	"	4.7	"	"	14
"	15.2	"	4.5	"	"	14½
"	15.2	"	4.4	"	"	14½
"	15.2	"	4.5	"	"	15
"	15	"	4.2	"	"	14
"	14.2	"	4.1	"	"	13¾

(3) Three lamellæ, superior, axial and basal. Six individuals = 10%.

Length	20.5,	diam.	4.9	mm.;	whorls	17
"	20	"	5	"	"	17½
"	20	"	4.9	"	"	17
"	19.5	"	4.9	"	"	17
"	19	"	5	"	"	17

In size, sculpture and shape, we can find no external character correllated with the differences in internal structure. The specimens from Station 5 are from one colony.

It will be seen that the typical *bilamellata* axial structure predominates, nearly 70% having that arrangement of lamellæ. The dimensions of this lot agree well with those given by Bartsch for 8 specimens in the U. S. Nat. Mus., but our lot, being larger, includes shells both larger and smaller than any in the original lot.

Holospira bilamellata longa n. form. Plate VII, figs. 2 to 2*b*.

Slender and pillar-like, the diameter contained four times or more in the length; whorls of the cone and last whorl costulate, 3 to 5 intermediate whorls usually smooth or nearly so. Aperture projecting laterally and forward; usually 3 internal lamellæ, in the *beginning* of the penultimate whorl, therefore ventral in position, the superior lamella generally very strong, and larger and longer than the basal.

Length	19.6,	diam.	4	mm.;	whorls	17
"	19.2,	"	4	"	"	18⅓
"	18.7,	"	4	"	"	17½

Length	17.9,	diam.	3.9	mm.;	whorls	17
"	17.1,	"	4	"	"	17
"	17,	"	4.25	"	"	15½
"	17,	"	3.9	"	"	15½
"	16.8,	"	4.2	"	"	15
"	16.3	"	4	"	"	15½

Station 4, on the south slope of Daniels Mt. near the summit. Types Nos. 112,269, A. N. S. P., collected by Pilsbry and Daniels. August 22, 1910.

Out of 20 shells opened, 16 have three lamellæ and 4 have two. the axial and basal. The pillar-like shape, numerous whorls, and prevalence of a superior lamella, as well as the deeper position of the lamellæ, are individually variable characters, yet in the aggregate they may suffice to define a race in this group.

These Holospiras live among rocks where there is very little xerophytic vegetation and the heat is terrific. The type lot was picked up at about the same elevation as Station 5, but there the exposure is less calorific, the sparse piñons and the cliffs afford shade, so that the soil retains some moisture.

Holospiras were seen scattered over a large area below and around Station 4.

Holospira bilamellata heliophila n. subsp. Plate VII, figs. 3 to 3c.

The shell is small, rather slender, with a long cone; *strongly costate throughout;* usually having axial and basal lamellæ within the middle part of the penultimate whorl. Peristome well expanded in the basal and columellar margins, but scarcely so near the upper angle.

(1) One lamella, the axial. 3 specimens = 15%.

(3) Three lamellæ, superior, axial and basal. 4 specimens = 20%.

Length	13.9,	diam.	3.7	mm.;	whorls	15½
"	13,	"	4	"	"	14

Station 1, northern and eastern sides of Teocalli Butte, at the base of the cliff. Types Nos. 112,265, A. N. S. P.

Twenty shells opened out of a series of over 250 show that the bilamellate form predominates. The largest shell noticed is 14.9 mm. long, the smallest 11.5 mm. There is rather wide variation in sculpture, but a large majority of the shells conform to fig. 3*a* in this respect.

Holospira bilamellata insolata n. subsp. Plate VII, figs. 4 to 4*a*.

The shell is slender, with a rather long terminal cone; *very strongly ribbed throughout;* composed of many (13½ to 17½) short, convex whorls, the last very shortly free in front. Peristome narrow, only very slightly expanded. Only the axial lamella developed in 14 out of 16 individuals opened, the other two having axial and basal lamellæ.

Length	15.5,	diam.	3.6	mm.;	whorls	17½
"	15,	"	3.8	"	"	16½
"	14.9,	"	3.5	"	"	16½
"	14.8,	"	3.8	"	"	16½
"	14.5,	"	3.6	"	"	15½
"	14,	"	3.8	"	"	15½
"	13.5,	"	3.8	"	"	15
"	13,	"	3.7	"	"	14½
"	13,	"	3.3	"	"	15½
"	12.25,	"	3.25	"	"	14
"	12,	"	3.9	"	"	13½
"	11.8,	"	3.9	"	"	13½ (axial and basal lamellæ).

Station 6, on the southeastern slope of the mountain south of Big Hachet Mt.

This form differs from *crossei* and *mearnsi* by the more slender shape, long terminal cone, more numerous whorls and strong sculpture. It agrees with *bilamellata* in having many whorls, but differs by its slender form, longer cone, the prevalence of unilamellate shells, etc. *H. b. heliophila* stands nearest to *insolata*, but in that race the bilamellate form predominates. It is more conspicuously ribbed than any of the other Hacheta races.

Holospira bilamellata media n. subsp. Plate VII, figs. 5 to 5*c*.

The shell is cylindric with a long terminal cone; composed of many closely coiled, convex whorls, all after the embryo rather strongly,

sharply costulate; buff-whitish except where darkened by the presence of the soft parts, the last whorl shortly projecting; peristome narrowly expanded. Internal lamellæ one to three, but axial and basal most frequent. 75 individuals opened from the type locality.

Southern and western portions of Sheridan Canyon, at Stations 2, 12 and 3. Types Nos. 112,268 A. N. S. P., from Station 3, at the base of a cliff near the mountain top, facing the mouth of Sheridan Canyon, in company with *Oreohelix ferrissi*.

Specimens from the type locality measure as follows:

(1) An axial lamella only. 22 individuals = 29⅓%.

Length	16.9,	diam.	4	mm.;	whorls	16
"	16.6,	"	4	"	"	17
"	15,	"	4	"	"	15½
"	14.2,	"	4	"	"	15
"	14,	"	3.7	"	"	13½
"	13.9,	"	4	"	"	14⅓
"	13.5,	"	3.9	"	"	14
"	13.3,	"	3.8	"	"	14½
"	12.2,	"	4	"	"	12½
"	12,	"	4	"	"	12½

(2) Axial and basal lamellæ. 48 shells = 64%.

Length	18.5,	diam.	4.25	mm.;	whorls	17½
"	16.5,	"	4.3	"	"	15½
"	16.5,	"	4	"	"	16½
"	16.2,	"	3.8	"	"	16
"	16,	"	4	"	"	16
"	15.5,	"	4	"	"	15½
"	15.1,	"	4	"	"	15½
"	14.2,	"	4	"	"	15

Also one shell which has two basal lamellæ. The upper partition was broken away in opening, so that the presence of a superior lamella is uncertain.

This form stands nearest to *H. b. mearnsi*, but the striation is sharper, not partially effaced on the later whorls and the cone is in the average longer. The habitats of *mearnsi* and *media* are rather remote from one another, and several other forms inhabit territory between them.

The specimens from Station 12 are more like *mearnsi*, the sculpture being weak on the penultimate and next earlier whorls. Out of 11 opened—

2 have one lamella, axial.
9 have two lamellæ, axial and basal.
1 has three lamellæ, axial, basal and superior.

Station 2 is on the northern slope of one of the ravines east of and running from Teocalli Butte, at the foot of an irregular projecting bench of limestone. It is much the lowest station where shells were found in the Hachetas. The shells are partly as rough as those from Station 3, but some approach those of Station 12. Out of 21 shells opened—

15 have two lamellæ, axial and basal.
6 have three lamellæ, axial, basal and superior.

In size the shells from Stations 12 and 2 are about equal to those from Station 3.

Holospira bilamellata mearnsi Dall. Plate VII, figs. 6, 6a.

Holospira (Haplostemma) mearnsi Dall, Proc. U. S. Nat. Mus., XVIII, 1895, p. 4; XIX, 1896, p. 350, Pl. 31, fig. 1.
Holospira (Distomospira) mearnsi Dall, Bartsch, Proc. U. S. Nat. Mus., XXXI, 1906, p. 134.

Six shells of the type lot, the measurements of which are given by Dr. Bartsch, measure 14 to 15.8 mm. long, 4.2 to 4.5 wide, with 14 whorls. Twenty shells were taken at our Station 8, on the eastern slope of Hacheta Grande Mt. (see map, p. 325). Ten were opened, 3 having only the axial lamella, which is very weak in two of them; 7 have axial and basal lamellæ. Measurements follow.

Length	17,	diam.	4.5	mm.;	whorls	15; an axial lamella.	
"	15,	"	4.5	"	"	15; axial and basal lamellæ.	
"	14.9,	"	4.5	"	"	14½	
"	14.5,	"	4.5	"	"	14	
"	14,	"	4.3	"	"	14; axial and basal lamellæ.	
"	13,	"	4	"	"	13½; " " "	
"	13,	"	4	"	"	13; " " "	
"	13.	"	3.9	"	"	12½; " " "	

Length 12.6, diam. 4 mm.; whorls 13½
" 12.5, " 4 " " 12½
" 11.3, " 4 " " 12; an axial lamella.

These shells connect *H. crossei* and *H. bilamellata*. Specimens of intermediate size agree exactly with one of the type lot of *mearnsi*, kindly lent from the National Museum. The smallest shells are indistinguishable from *crossei*, while the largest could not be separated from small *bilamellata*. Yet the colony as a whole has a certain individuality by its intermediate size, and as the form has been named, we let it stand as a convenient place for *crossei-bilamellata* intergrades. It is attached to *H. bilamellata* rather than to *H. crossei*, because the prevalent form, in the small lot opened, is bilamellate. All of the shells were collected in one spot where the writer sat resting. A large quantity could have been gathered had time and strength permitted. A few specimens are quite finely striate, while others are rather coarsely ribbed, like the type of *mearnsi*; still others being intermediate in sculpture. The sculpture in some shells becomes very much weaker on the penultimate and next earlier whorls.

H. mearnsi served as monotype of the subgenus *Haplostemma* Dall, characterized by the possession of an axial lamella only. Bartsch, opening another specimen, found a basal lamella also, and concluded that that lamella had been broken away in opening the original specimen. Since some fully adult examples are known to have an axial lamella only, it is likely that Dall's original diagnosis was correct for the specimen he opened, while Bartsch was also right as to the shell he examined and which we have seen.

Holospira crossei Dall. Plate VII, figs. 7 to 7c.

there is decidedly more vegetation. A few were picked up on the slope towards Station 10, dead shells being scattered all over the upper 500 ft. or more of this ascent.

Sixty specimens were opened, measurements of 31 being given below.

(1) No axial lamella, merely a callous or very inconspicuous node on the axis in the penultimate whorl. 15 individuals = 25%.

Length	14,	diam.	4	mm.;	whorls	13;	penult.	whorl	smooth.
"	12.8,	"	3.9	"	"	13;	"	"	"
"	12.3,	"	3.9	"	"	12½;	"	"	weak ribs.
"	12,	"	3.9	"	"	12½;	"	"	smooth.
"	12,	"	3.8	"	"	12;	"	"	strong ribs.
"	11.8,	"	4	"	"	12⅓;	"	"	weak ribs.
"	11.3,	"	3.7	"	"	12	"	"	" "
"	11,	"	3.6	"	"	11½;	"	"	smooth.
"	10.5,	"	3.8	"	"	11;	"	"	"

(2) Axial lamella in penultimate whorl short and strong; no other lamellæ. 30 individuals = 50%.

Length	13,	diam.	4	mm.;	whorls	12¾;	penult.	whorl	weak ribs.
"	12,	"	4	"	"	12;	"	"	" "
"	12,	"	3.8	"	"	12;	"	"	" "
"	11.8,	"	3.9	"	"	11½;	"	"	smooth.
"	11.8,	"	3.8	"	"	11½;	"	"	"
"	11.3,	"	3.6	"	"	12;	"	"	"
"	11,	"	3.9	"	"	11½;	"	"	"
"	11,	"	3.9	"	"	11;	"	"	weak ribs.
"	10.8,	"	3.9	"	"	11;	"	"	smooth
"	10.5,	"	3.7	"	"	10¾;	"	"	strong ribs.
"	10.5,	"	3.3	"	"	11½;	"	"	" "

(3) Axial lamella short and strong or rarely weak; a basal lamella within last half of penultimate whorl. 12 specimens = 20%.

Length	13,	diam.	4	mm.;	whorls	13¾;	penult.	whorl	smooth.
"	13,	"	4	"	"	12½;	"	"	weak ribs.
"	13,	"	3.8	"	"	13½;	"	"	" "
"	12.7,	"	3.9	"	"	12½;	"	"	smooth.
"	12.5,	"	3.8	"	"	12;	"	"	"
"	12.3,	"	3.5	"	"	12½;	"	"	strong ribs.
"	11.1,	"	3.8	"	"	12;	"	"	" "
"	11,	"	3.9	"	"	11¼;	"	"	weak ribs.

(4) Axial, basal and superior lamellæ in the last half of penultimate whorl. 3 individuals = 5%.

Length	14,	diam.	4	mm.;	whorls	13;	penult.	whorl	weak ribs.
"	13,	"	4	"	"	12½;	"	"	strong ribs,
"	12.7,	"	4.1	"	"	12½;	"	"	smooth.

The embryonic shell, of slightly over 2 whorls, is smooth and projects nipple-like. The following whorls of the cone are strongly ribbed, but the ribs weaken more or less on the cylindrical part, so that on the penultimate whorl they are often inconspicuous or almost wanting (for brevity called "smooth" in the above tables). There is of course complete intergradation in this character, so that the classification in the table is more or less arbitrary. The size averages larger in shells with 2 or 3 lamellæ, but there are exceptions. It will be understood that the measurements were based upon shells which to all external appearance are adult or old. After a careful study of the aperture and lip, I think that it may be accepted as certain that the variations in lamellæ recorded above are not dependent upon age of the individual.

At Station 10, on the northern slope of Hacheta Grande Mt., a small series was taken. All of them have the whorls of the cylindric portion smooth or nearly so, glossy, the cone and the last whorl, or its last half, being ribbed as usual. Ten specimens opened measure as follows:

Length	14.2,	diam.	4	mm.;	whorls	14;	axial and basal lamellæ.
"	13.1,	"	4.1	"	"	12½;	" " " "
"	13,	"	4.4	"	"	12½;	" " " "
"	13,	"	4.2	"	"	12½;	" " " "
"	12.9,	"	4	"	"	12½;	" " " "
"	12.1,	"	4.1	"	"	12;	axial lamella only.
"	11.5,	"	4	"	"	12;	" " "
"	11.5,	"	4	"	"	12;	" " "
"	11.3,	"	3.9	"	"	11⅓;	" " "
"	10.3,	"	3.3	"	"	11½;	" " "

This lot, by the size of some individuals and the large number

PUPILLIDÆ.

Pupilla sonorana (Sterki).

Station 11. Abundant on the summit of Big Hachet Mt.

Bifidaria pellucida hordeacella (Pils.).

Stations 3, 5, 8 and 11.

A peculiar short cylindric form, having less convex whorls, less tapering spire and blunter summit, was taken at Stations 3 and 5.

Bifidaria pilsbryana Sterki.

Stations 8 and 11.

Bifidaria ashmuni Sterki.

Stations 3, 5, 8 and 11.

VALLONIIDÆ.

Vallonia sonorana n. sp. Fig. 5.

The shell is very broadly, openly umbilicate, width of umbilicus contained about three times in the diameter of shell; whitish corneous. First 1½ whorls smooth, corneous, glossy; following whorls with sculpture of rather delicate riblets about 38–40 on the last whorl, in fresh specimens bearing irregular cuticular extensions; the spaces between ribs delicately striate, the striæ irregularly anastomosing. Whorls 3¾, strongly convex, rather slowly widening, separated by a

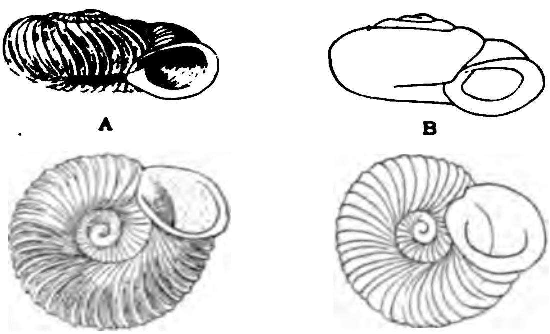


Fig. 5.—*Vallonia sonorana.* A, type; B, thick-lipped form.

deep suture; the last whorl deeply descending close to the aperture. Aperture small, nearly circular, very oblique. The peristome is expanded and reflexed, slightly thickened within (in old specimens strongly thickened); the margins converge strongly and are connected by a very short parietal callus or are continuous, joined by a thin, slightly raised callus. The ample umbilicus is somewhat oblong.

Alt. 1.1, diam. 2.7 mm. (type, fig. 5A).
" 1.2, " 2.6 " (fig. 5B).

Summit of Big Hachet Mountain, Station 11. Type No. 112,012, A. N. S. P., collected by Pilsbry, August 25, 1910.

This species is abundant at Station 11, in the dirt under stones. It is more closely related to *V. perspectiva* Sterki than to any other, but it is a very much larger shell. *V. cyclopherella* has far finer striation. *V. gracilicosta* has closer riblets and a much smaller umbilicus. *V. albula* has a smaller umbilicus.

Having collected and identified some thousands of the Vallonias of Arizona and New Mexico in the last ten years, it was a surprise to find a species which differs conspicuously from the three mountain species mentioned above. As we have not found *V. sonorana* elsewhere in our work in southern New Mexico and Arizona, it seems likely that it is a southern species which barely crosses the international boundary. As a rule, Vallonias are rather widely distributed snails.

The Holarctic genus *Vallonia* now comprises about 25 recent and pleistocene and a half dozen tertiary species, besides about a dozen named varieties. It is likely that some of these are mere synonyms. We have nine recent species in the United States, all of them readily recognizable, except *V. excentrica*, which is often hard to tell from *pulchella*.

Vallonia perspectiva Sterki.

Station 11, a few specimens taken with the preceding species.

II. The Florida Mountains.

The Florida range (accent on the i) is about

Spring Canyon.[7] This is above the middle of the west side of the range. The summit here projects as a limestone butte, bounded by cliffs on the east, north and west sides. Access was gained to the top on the south side. The flat summit is covered with grass, *Fouquieria*, *Cylindropuntia* and other cacti, *Agave*, etc. No shells. There is a fine outlook, the jagged Organ Mountains silhouetted eastward. Around the base of this central summit we found *Ashmunella walkeri* and *Sonorella* by digging in the soil among the rocks, where there was shade. We found only seven species of snails in all.

Sonorella hachitana flora n. subsp. Plate V, figs. 3 to 3c.

Sonorella hachitana. . . . Florida Mountains, Pilsbry, Proc. A. N. S. Phila., 1905, p. 257, Pl. 17, figs. 1–6 (shell), Pl. 20, fig. 12 (genitalia), Pl. 23, fig. 20 (jaw).

The shell is in the average larger than *S. hachitana*, with less distinct white borders along the shoulder band. Penis decidedly

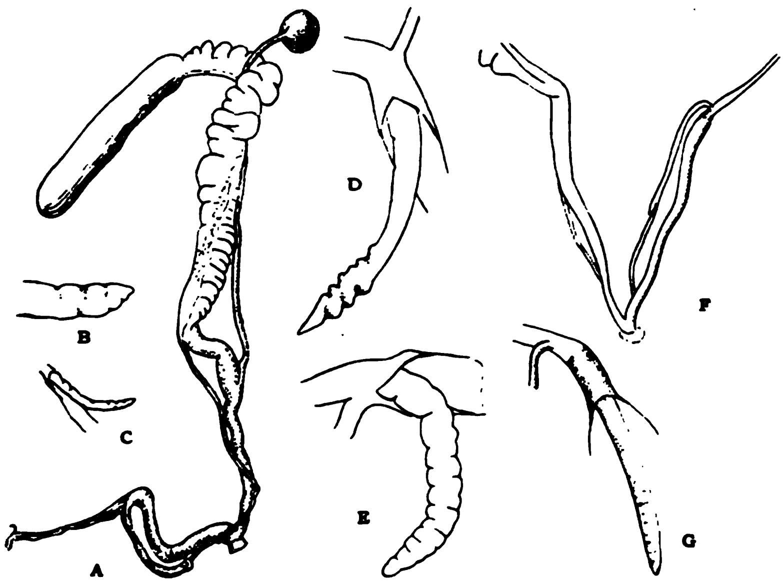


Fig. 6.—A–E, *Sonorella hachitana peloncillensis*. A, genitalia; B, C, penis-papilla and end of same, enlarged; D, E, penis-papilla, two other individuals. F, G, *S. h. flora*, terminal ducts and penis-papilla.

[7] This spring is not indicated on the U. S. G. S. Topographic Sheet (Deming Quadrangle, edit. of Feb., 1899), and as our visit to these mountains was unforeseen, we did not have the map. From memory we would say this spring is opposite Arco del Diablo of the map. Mr. Ferriss had made a flying visit to the range a year earlier, collecting ferns and a few snails on the slope facing the Little Floridas.

longer, but the papilla and epiphallus only slightly or not longer than in *hachitana*.

Alt. 16, diam. 27, umbilicus 4 mm.

120 specimens measure as follows, the upper line being diameters in mm.,[8] the lower line the numbers of specimens of each size:

22.7	23.7	24	24.5	25	25.5	26	26.5	27	27.5	28	28.5	29	29.7
1	1	10	11	18	12	17	16	13	7	3	7	3	1

The genitalia of *S. h. flora* (fig. 6, F, G) resemble the same organs in *S. hachitana*, except that the penis is decidedly and constantly longer, as are also the vagina and spermathecal duct. The penis-papilla is indistinctly annulate and tapers slowly to the apex. The penis-retractor is long and slender, attached to the apex of the penis, and enveloping the base of the epiphallus. Measurements of the organs have been given on page 328.

The pallial organs are much as in *Sonorella optata*, but there is no white thread defining the secondary ureter.

The sole, in alcoholic examples, resembles that of *Sonorella bicipitis*. It is ochraceous in the middle, pale gray at the sides. Back and flanks dark slate-gray, the tail fleshy-gray above, having an indistinct median line.

Jaw and teeth were described in a former paper of this series.

Ashmunella walkeri Ferriss. Plate V, figs. 2 to 2*e*.

This species was originally described from a few dead shells. We found it living in abundance by digging in the soil among the rocks where there was shade. It lives in families or "pockets." The snails are very hard to pull, scarcely any coming out entire

Oreohelix strigosa var.

Two broken and very old "bones" were found near the central peak above the spring, where we found *Ashmunella* and *Sonorella*. The largest one, evidently adult, has the periphery bluntly angular in front, becoming rounded on the last half whorl. There are faint traces of bands above and below it. Spire rather elevated. Height 10.6, diam. 17.5, umbilicus 4 mm. It differs from *O. s. depressa* by the angulation of the periphery. Possibly an exploration of the southern end of the range, which from a distance looks rather good, would reveal living Oreohelices, but we looked for them in vain in the central and northern parts.

Thysanophora hornii (Gabb).

Vallonia perspectiva Sterki.

Bifidaria pilsbryana Sterki.

Bifidaria ashmuni Sterki.

III. Peloncillo Mountains.

Sonorella hachitana peloncillensis n. subsp.

The shell is a little less depressed than *hachitana*, with the last whorl not so deeply descending, the aperture not so oblique and a trifle larger.

Alt. 13.5, diam. 23.7, umbilicus 3.8 mm.
" 12.5, " 22.8 mm.
" 11.7, " 19.6 "

Peloncillo Mountains: Skull Canyon, Grant Co., New Mexico. Types, No. 94,513, A. N. S. P., collected by J. H. Ferriss, 1907.

The genitalia (figs. 6A to 6C, and figs. 6D, E, penis-papillæ of other individuals) resemble the same organs in *S. flora*. The penis is encircled by *a sheath which reaches nearly to the middle*. The penis-papilla is slender, tapering, and subannulate or rather strongly annulate. Epiphallus and flagellum as usual in the group of *hachitana*. It differs from *S. hachitana* by the decidedly longer penis, which has a much longer basal sheath. The vagina is slightly shorter than the penis, while in *S. hachitana* and *flora* it is slightly longer. Measurements are given on page 328.

The sole is fleshy-buff, of nearly uniform tint, the side areas not distinct. Back ashy; sides and tail flesh-tinted.

Explanation of Plates V, VI, VII.

Plate V—Figs. 1, 1*a*, 1*b*, 1*f*.—*Ashmunella mearnsi* (Dall). Station 5, Big Hachet Mts.
Figs. 1*c*, 1*d*, 1*e*.—*Ashmunella mearnsi* (Dall). Station 11.

Figs. 2–2*e*.—*Ashmunella walkeri* Ferriss. Florida Mts.
Figs. 3–3*c*.—*Sonorella hachitana flora* n. subsp. Florida Mts.
Figs. 4–4*b*.—*Sonorella hachitana* (Dall). Station 7.

Plate VI—Figs. 1–1*d*.—*Oreohelix hachetana* n. sp. Cotypes. Station 11.
Fig. 2.—*O. h. cadaver* n. subp. Type. Station 5.
Fig. 3.—*Oreohelix ferrissi morticina*. Type. Station 5.
Figs. 4, 4*a*, 4*c*.—*Oreohelix ferrissi* Pils. Shells denuded of the cuticle and cuticular processes. Station 3.
Figs. 5–5*c*.—*O. ferrissi* Pils. Cotypes. Station 3.
Fig. 5*d*.—*O. ferrissi* Pils. Young specimen, showing the embryonic and $1\frac{1}{3}$ neanic whorls. Station 3.
Fig. 6.—*Oreohelix hachetana*. Embryonic and part of the first neanic whorls of a paratype. Station 11.

Plate VII—Figs. 1–1*d*.—*Holospira bilamellata* Dall. Station 5. Topotypes.
Figs. 2–2*b*.—*H. b. longa* n. subsp. Cotype. Station 4.
Figs. 3–3*c*.—*H. b. heliophila* n. subsp. Cotypes. Station 1.
Figs. 4, 4*a*.—*H. b. insolata* n. subsp. Cotypes. Station 6.
Figs. 5–5*c*.—*H. b. media* n. subsp. Cotypes. Station 3.
Figs. 6, 6*a*.—*H. b. mearnsi* Dall. Station 8.
Figs. 7–7*c*.—*H. crossei* Dall. Station 11. Topotypes.

THÉORIE DU GNEISS ET DES TERRAINS CRISTALLOPHYLLIENS EN GÉNÉRAL.

PAR STANISLAS MEUNIER.

Les études que je poursuis depuis de nombreuses années sur le régime géologique des profondeurs de l'écorce terrestre et qui m'ont amené à une conception personnelle du mécanisme volcanique[1] m'ont mis progressivement dans la nécessité de formuler quelques conclusions sur les traits les plus généraux du métamorphisme sédimentaire, ou normal, et sur le mode de formation des roches cristallophylliennes. La distance qui sépare le volcanisme du métamorphisme est d'ailleurs, selon moi, beaucoup moins considérable qu'on ne l'imagine quelquefois, au point que j'y vois avant tout deux formes d'une même disposition générale naturelle.

Dans mon opinion, en effet, le volcanisme et le métamorphisme sédimentaire résultent l'un et l'autre de la collaboration de deux facteurs également indispensables: d'un côté le pénétration souterraine de l'eau et des matières comparables, en circulation dans des régions à température convenablement élevée; et d'autre part, la réduction des roches imprégnées, en fragments de toutes grosseurs, par le moyen de réactions mécaniques engendrées dans la substance de la croûte par la contraction spontanée du noyau fluide sous-jacent.

Le développement simultané de ces deux actions et la combinaison, à chaque instant réalisée, de leurs effets procure l'explication de tout ce qui concerne la manière d'être, la composition et la variété des roches métamorphiques, en même temps qu'ils rendent compte de tout ce qui a trait au phénomène éruptif.

A cet égard, et pour préciser la discussion, il est indispensable d'éliminer un point de vue qui a cependant, un temps, rallié tous les suffrages et dont il sera facile de démontrer l'inexactitude. C'est de faire des roches cristallophyliennes les produits d'une fusion ignée, toute pareille à celle qu'on réalise en chauffant des creusets dans les fourneaux.

Dans le nombre des travaux de ce genre, nous devons faire une place aux recherches que MM. Fouqué et Michel Lévy ont poursuivies de 1878 à 1891 et dont ils ont exposé la signification dans

[1] *La Nature* du 24 mai 1902, p. 386, Paris.

leur ouvrage intitulé *Synthèse des Minéraux et des Roches*, p. 45 (Paris, 1882). "Nous avons entrepris," disent-ils, "une série d'expériences dont le résultat est d'augmenter considérablement le domaine de la fusion purement ignée. Les conclusions à tirer de nos recherches peuvent en effet se résumer comme il suit: un grand nombre de roches éruptives anciennes et modernes doivent leur origine à l'action exclusive d'une fusion, suivie d'un lent refroidissement, les fumerolles et les agents volatils ne produisant que la décomposition ultérieure des minéraux primitifs de ces roches, leur action est purement secondaire." Conclusion formelle qui repose sur ce raisonnement que, si une expérience donne naissance à un produit semblable à un minéral naturel, la méthode mise en œuvre par l'expérimentateur coïncide nécessairement avec le mode opératoire de la nature. Or, c'est là une incontestable imprudence.

Je sais bien que la fusion ignée a fourni maintes "synthèses" de haute valeur pour la chimie et même pour la minéralogie; je sais bien que Mitscherlich a démontré l'identité, avec la fayalite ou péridot ferrugineux, de certains cristaux contenus dans des laitiers métallurgiques; Ebelmen a imité, dans leurs composition et dans leur forme, le rubis balai et les autres spinelles, en faisant évaporer la solution de leur constituants dans l'acide borique, fondu au feu des fours à porcelaine; que Hautefeuille a préparé des cristaux de feldspath orthose de la même façon, en employant comme dissolvant le molybdate de potasse liquéfié par la chaleur rouge; que bien d'autres succès ont été obtenus dans la même voie par bien d'autres expérimentateurs et pour bien d'autres minéraux. Mais ces résultats ne comportent aucune conséquence dont puisse profiter la Géologie. En conclure que les minéraux mentionnés sont des produits de [redacted]

d'anciens éléments par des "éléments juvéniles." Ajoutons qu'en 1899, MM. Fouqué et Michel Lévy[3] sont revenus sans paraitre l'en apercevoir eux mémes sur leurs assertions précédentes, en relatant des résultats procurés par le recuit de verres de granit *dans l'eau suréchauffée.*

Sans contester la ressemblance des résultats artificiels avec des minéraux natifs, il reste indispensable de constater que la structure microscopique des roches cristallophylliennes est en réalité, et quoi qu'on ait souvent supposé, incompatible avec l'hypothèse de la fusion ignée.

Nous savons par les expériences de Sénarmont[4] et de ses successeurs que, par l'effet combiné de la chaleur et de la pression, l'eau remanie la substance terreuse des sédiments et la convertit en minéraux cristallisés semblables à ceux dont sont faits les terrains cristallophylliens. Nous savons aussi que, pour obtenir ces résultats, il suffit que l'eau suréchauffée soit portée à une température incomparablement plus faible que celle où fondraient les matières modifiées: c'est à 300° seulement que Daubrée, par la décomposition du verre dans l'appareil de Sénarmont, a fait cristalliser le pyroxène diopside, comme Sénarmont avait déjà fait cristalliser le quartz. Nous savons enfin, par l'étude des blocs de calcaires stratifiés, rejetés en mélange avec les produits volcaniques de la Somma,—après leur séjour éphémère en certains points du laboratoire souterrain,—que le régime de celui-ci y a engendré des séries de minéraux comparables à ceux que l'eau suréchauffeé sait produire.

Toutefois, il faut convenir que les résultats de Sénarmont, considérés en eux seuls, et quelque admirables, qu'ils doivent nous apparaîte, ne sont pas suffisants pour rendre compte de la différence ordinaire de composition entre les roches sédimentaires et les roches cristallines. A la place d'assises formées, chacune pour son compte, de calcaire, ou de sable, ou d'argile, ou de gypse, ou de limonite, ou de houille, etc., nous trouvons des masses dont chaque centimètre cube est d'une complication minéralogique extrême, où des minéraux très divers sont associés intimement, témoignant avant tout d'un régime où devaient prédominer les causes de mélange, au lieu des actions de triage, génératrices des dépôts stratifiés. Pour concevoir dans ceux-ci le point de départ de la dérivation des roches cristallines, il faut évidemment faire intervenir des actions mécaniques rapprochant les uns des autres des matériaux tout d'abord très distants et désor-

[3] Bull. Soc. Géol. Fr. (4) XXIV, 129.
[4] Ann. Chim. et Phys. (7) XXX, *passim.*

ganisant des accumulations homogènes, pour en éparpiller les débris plus ou moins loin.

Il ne faut pas oublier à cette occasion que le mélange en proportions convenables des roches sédimentaires les plus communes, fournit à l'analyse la même composition chimique que les roches cristallines. Et c'est pourquoi nous assistons parfois et, par exemple, dans l'epaisseur de houillères, qui, comme à Commentry ont éprouvé suffisamment longtemps un embrasement accidentel, des produits imitant, en tout ou en partie, pour leur composition minéralogique, des roches éruptives de la catégorie des laves.[5]

Or, c'est précisément cet ensemble de réactions qui parait avoir laissé ses traces dans la substance des formations métamorphiques et cristallophylliennes. Malgré la dimension gigantesque de ces formations, c'est dans l'intimité de leur structure qu'on doit espérer retrouver, comme à la piste, les conditions mêmes de leur élaboration.

D'ailleurs, tout le monde est d'accord à ce sujet, au point qu'à première vue, la remarque semble bien inutile. Elle n'est cependant pas aussi banale qu'elle peut le paraître tout d'abord, car il n'y a certainement pas de chapitre des sciences géologiques qui ait été aussi activement étudié que l'examen microscopique des roches cristallines préalablement réduites en lames minces. Les savants les plus distingués, voire les plus illustres, ont à l'envi collaboré à ses progrès et les résultats acquis sont de première valeur pour l'analyse des roches et pour leur détermination minéralogique. Mais au point de vue géogénique, ils ont été déformés par l'idée préconçue de la fusion ignée.

Il peut sembler étrange qu'on vienne dire en face à la légion innombrable des lithologistes: "Vous décrivez inlassablement les

laboratoires souterrains, sont avant tout, et au pied de la lettre, *des produits de trituration*, résultant des fins débris de matériaux très divers, malaxés et pétris les uns avec les autres, puis cimentés entre eux par une substance conjonctive de composition variable.

Aussi a-t-on, certe, bien le droit de s'étonner qu'une pareille structure, si bien reconnue et si bien décrite par tous les lithologistes du monde entier, n'ait pas fait rejeter depuis longtemps une hypothèse très antérieure à toute notion histologique des roches. Notons cependant en passant que des faits, bien anciennement aperçus proclamaient, jusque dans les laves volcaniques, et au moment même de leur extravasement sur le sol, un état différent de la fusion proprement dite. On avait constaté, dans le sein de la masse fluide, des grains déjà parfaitement solides, cristallins, ayant même subi des détériorations, à la suite de chocs et de froissements. C'est pour consacrer cette circonstance si imprévue que Haüy a appliqué au plus visible des minéraux dont il s'agit, le nom caractéristique de *pyroxène:* étranger au feu.

Pour nous, ce nom exprimera le mode de formation du minéral par voie mixte (eau suréchauffée) et nous le traduirons par: étranger à la fusion du creuset (voie sèche). C'est comme si Haüy avait eu l'intuition de la vérité qui éclate aujourd'hui, et le microscope nous montre maintenant que les minéraux plus fins que les gros pyroxènes n'ont pas, plus qu'eux, été formés par fusion sèche. Comme eux, ils ont été amenés en grains plus ou moins fragmentaires, anguleux ou émoussés, associés à des fluides, liquides, vapeurs et gaz comprimés, qui imprégnaient le magma général.

Non seulement la structure des roches cristallines résulte du mélange de minéraux dont le point de fusion, généralement très élevé, est très variable de l'un à l'autre; non seulement elle admet en contact les substances qui, comme le quartz et le péridot, auraient par fusion réagi les unes sur les autres et donné du pyroxène par la transformation du *proto* en *bisilicate de magnésie;* mais encore elle s'accommode, comme nous venons de le dire, de la réduction de l'immense majorité des minéraux constituants en fragments souvent anguleux, à cassures vives et non émoussées, si énergiquement séparés les uns des autres que l'on n'y voit que très exceptionnellement des formes qui, à la rigueur, pourraient se raccorder. En outre, de tous côtés, se présentent des plages, de quartz, par exemple, dans la substance desquelles de très petits débris de minéraux concassés sont très exactment empâtés,—à peu près comme les éléments des *brèches* des filons concrétionnés.

La raison de cet état de choses nous apparaît comme très compréhensible, par l'examen de phénomènes que nous ne pouvons considérer comme transitoires, puisque leur série compose précisément un acheminement vers lui. Ils sont procurés par des roches sédimentaires peu métamorphisées et dont les couches ont été seulement contournées, comme il en existe beaucoup dans les régions marginales des montagnes.

Dans le canton de Vaud, par exemple, à Brent, auprès de Montreux, j'ai recueilli des crochons de calcaire argileux du lias, où l'on voit nettement que la torsion des couches, du reste à très petite courbure, a été réalisée, malgré le manque absolu de plasticité du calcaire.[6] Le calcaire a été broyé par la déformation, mais les débris, parfois très petits, ont été exactment maintenus en place par leur emballage entre les couches voisines et la circulation des eaux souterraines dans le réseau des fisssures produites, a comblé ces dernières par la concrétion lentement opérée, de calcite et de quartz cristallins. Le phénomène s'est sans doute reproduit une série de fois et c'est ainsi que la roche s'est progressivement repliée d'une manière très serrée, jouissant d'une *fausse plasticité*, de tout point comparable à celle qui permet à la glace des glaciers de se mouler sur la forme des vallées, dont ceux-ci occupent le thalweg.

Le résultat, produit sur une échelle relativement faible dans la roche argilo-calcaire de Montreux, s'est developpé avec une intensité incomparable dans le gneiss et dans les roches analogues, où le développement de la schistosité, comme la production de plis et de contournements inextricables, s'est accompagnée de la pulvérisation et de la cimentation alternatives des fragments produits et de plus en plus écartés les uns des autres, par le mouvement

La masse pesante qui aurait ainsi rampé sur le Brianconnais, faisant l'office d'un traîneau écraseur . . . etc." Je me borne à noter que la coupe, que j'ai insérée en 1902, dans le journal *La Nature*, conformément à l'indication donnée au début du présent travail, ne laisse aucune incertitude quant à mon opinion personnelle. Elle met sous les yeux du lecteur, le développement d'un phénomène souterrain, dont la cause dynamique est toute trouvée dans la contraction même du noyau terrestre. Par cette coupe, on s'explique comment la superposition de terrains anciens sur des terrains plus récents, est le régime ordinaire,—parce qu'il est nécessaire,—des régions montagneuses; comment des paquets de roches supportés, par une géoclase faiblement inclinée sur l'horizon et surmontée de massifs énormes et puissamment pesants, out sû gravir peu à peu la rampe qui se présentait devant eux et, au moins en certains cas, abandonner leurs "racines"; comment ils ont dû infliger à leur support, et subir eux-mêmes, des plissements, des ruptures et des écrasements, mélangeant des débris de leure parties séparées.

En général aussi, on raisonne comme si le phénomène mécanique était complètement distinct du phénomène métamorphique et comme si, par conséquent, une masse gneissique charriée à un nombre quelconque de kilomètres de son point de départ, pouvait être restée identique à ce qu'elle était à ses débuts. M. Termier a écrit.[8] "Les actions mécaniques *déforment;* elles ne *transforment* pas. Si l'on veut, comme moi, réserver le nom de métamorphisme à une cause capable de changer sur d'énormes épaisseurs et d'immenses étendues, un terrain quelconque en une véritable série cristallophyllienne, il n'y a pas de métamorphisme purement dynamique, il n'y a pas de dynamo-métamorphisme." Tout le monde sait bien que les actions mécaniques qui déforment, en même temps échauffent et, dès lors, elles peuvent et doivent déterminer des effets chimiques au sein des masses où elles s'exercent, de telle sorte que l'assertion que nous venons de citer nous apparaît comme la méconnaissance absolue du phénomène naturel. C'est de la même cause que résulte l'erreur, encore professée généralement, quant aux conditions chimiques dans lesquelles ont été élaborées, et s'élaborent encore, les roches métamorphiques, aussi bien que les roches volcaniques.

Rappelons que les unes et les autres constituent une longue série de types, réunissant les masses initiales de condensation gazeuse aux dépôts sédimentaires même les plus récents. Cette liaison qui,

[8] Sur la genèse des terrains cristallophylliens C. R. *XI*[e] *congr. géol. intern.* p. 588, Stockholm 1910.

en écartant la tentation d'admettre des interruptions dans l'évolution planétaire, comporte la plus haute signification philosophique, permet de suivre pas à pas les transformations d'une vase sablo-argileuse en schiste ardoiser, en micaschiste et en gneiss: évolution qui n'est qu'un détail du développement normal de la terre. Ainsi apparaît la finalité du métamorphisme, qui permet l'évolution planétaire sans altération des conditions de continuité à la surface, et par une circulation verticale ou *orogénique* de la matière des roches.

La pénétration de l'eau en profondeur résulte surtout de l'ensevelissement progressif de chaque sédiment sous l'empilement des dépôts qui lui succèdent.

Les matériaux de recouvrement exercent en effet, sur le sédiment choisi comme exemple, des effets complexes: par leur poids, ils lui donnent, suivant les cas, plus ou moins de compacité et le privent d'une fraction plus ou moins grande de son eau d'imbibition initiale; par leur faible conductibilité calorifique, ils lui conservent un échauffement qui va en augmentant au fur et à mesure des progrès de l'enfouissement.

Mais il importe extrêmement de constater, et nous ne saurions trop y insister, que le milieu rocheux sur lequel va s'exercer la collaboration des solutions souterraines et de la chaleur, est soumis à un régime essentiellement mécanique. Par suite des circonstances déjà indiquées, il éprouve des compressions inégales suivant les point et diversement orientées. La pesanteur, qui détermine la compacité, purement sédimentaire, et qui agit de haut en bas, doit se composer avec les poussées tangentielles dérivant de la contraction du noyau et dont la direction peut être considérée comme horizontale. En outre, les réactions internes développent, soit des

morphisme et où a lieu, comme cas particulier, la genèse des terrains cristallophylliens.

L'ensemble des fissures microscopiques, qui constitue le fait le plus frappant des roches qui nous occupent, est comparable à un réseau capillaire, dans lequel les fluides de profondeur, eau surchauffée et autres, circulent avec une activité incessante et variable suivant les points et les instants. Parmi les réactions qui s'y développent et qui font assister l'esprit à une sorte d'*intussusception* rappelant celle des tissus organiques, on doit mentionner les précipités de matériaux, en lacis conjonctifs, des débris dérivant de l'écrasement. Et c'est pour cela que, dans les granits, par exemple, les gneiss, les micaschistes, on voit de toutes parts de petits éclats de mica, inclus dans des plages de quartz et d'autres substances, sans que la netteté de leurs cassures ait été en rien altérée par un émoussement ou par un bourrelet, tels qu'en produirait la situation dans un bain de cristal de roche en fusion.

Il va de soi qu'il faut compter, dans les causes de modification de ces phénomènes,—outre la variation de composition des courants minéralisateurs, provenant de localités changeantes,—les déplacements verticaux déterminés par les bossellements généraux, c'est-à-dire la progression souterraine des lames de charriage. Pendant l'ascension vers la surface, les conditions du milieu ambiant s'adoucissent et les travaux minéralogiques internes se restreignent jusqu'à s'arrêter. Mais la subsidence compensatrice de segments voisins, transporte dans ceux-ci les conditions mêmes que nous venons d'indiquer. De sorte que nous ne pouvons douter de l'existence au moment précis où nous sommes, et dans des lieux convenablement situés, de toutes le sconditions nécessaires à l'élaboration des gneiss et des roches connexes.

On voit donc que la "cataclase" intense et ininterrompue des masses cristallophylliennes présente une importance véritablement dominatrice dans toute l'économie planétaire. Celle-ci a, comme moteur décisif, l'association des actions mécaniques aux influences chimiques et thermiques qu'on a considérés jusqu'à ce moment comme seules indispensables, niant complètement la part du dynamisme. Répétons que c'est seulement à cause du broyage et du rebroyage incessants des roches en voie d'évolution, que des agents chimiques, véritables fluides interstitiels des éléments minéralogiques, peuvent, par une circulation quasi-moléculaire, aller extraire peu à peu des roches les principes caractéristiques des dépôts sédimentaires comme le calcaire, pour y engendrer et y substituer, par une véritable

synthèse, les minéraux cristallophylliens, comme les feldspaths et les autres silico-aluminates alcalins et terreux. En 1893, M. Lepsius prétendait,[9] distinguer des *Klastogneiss* des gneiss ordinaires; cette division est complètement illusoire; on doit y renoncer: il n'existe que des gneiss de dislocation.

En définitive, on est en mesure maintenant de suivre toutes les phases de l'évolution lithogénique, depuis le dépôt qui s'accumule au fond d'un bassin sédimentaire, à travers tous les types métamorphiques, jusque au gneiss et au granit.

Le travail souterrain, contrepartie exacte des fonctions superficielles, reconstitue ainsi la manière de *minerai* d'où celles-ci tirent les substances simples des assises stratifiées. C'est la constatation d'un cycle continu, déjà soupçonné par Lyell, et les géologues qualifiés d'*actualistes*, et auquel le point de vue *activiste*[10] donne une allure et une portée toutes nouvelles.

Il importe d'ajouter que la cataclase est un phénomène beaucoup plus considérable encore que, les faits précédents malgré leur ampleur, ne le feraient supposer. Je tiens, en terminant ce travail, à préciser le rôle de ce phénomène dans l'histoire des roches extraterrestre, tenant à ne pas laisser passer cette occasion de souligner, par un exemple spécialement frappant, la portée philosophique et la fécondité éducatrice de la Géologie Comparée.

La structure bréchiforme d'un grand nombre de météorites a frappé tous les observateurs, qui cependant n'en ont pas compris la haute signification. MM. Fouqué et Michel Lévy ont pensé en dévoiler la cause: "La fréquence de ce phénomène (les brèches microscopiques) dans les météorites peut être, disent-ils,[11] rapportée, soit à un mouvement explosif, qui les a lancées dans l'espace, soit à

que la constatation, si banale, de la cataclase chez les météorites doit être rangée parmi les faits les plus éloquents qui conduisent à reconnaître, dans les blocs de roches tombant du ciel, des débris provenant d'un seul et même organisme planétaire ayant évolué exactement comme notre globe lui-même. Seules, en efet, les réactions actuellement en cours dans la masse terrestre sont capables d'expliquer les détails de l'histologie météoritique. La cataclase, étendue à l'histoire des météorites, est un argument nouveau et décisif pour démontrer la réalité des initiales relations stratigraphiques des divers types de roches cosmiques.

Il y a même plus encore; si l'observation de la croûte terrestre éclaire ainsi leur histoire, ces roches à leur tout permettent de préciser, dans le mécanisme du broyage orogénique, des détails que les roches terrestres étudiées seules sont en général impuissantes à nous révéler. Ce sont certaines météorites métalliques, dont la malléabilité a permis l'inscription, dans leur substance, de réactions mécaniques dont s'est accompagné leur broyage durant les efforts tangentiels de la contraction, ou systole planétaire.

Sans m'arrêter au cas bien connu de véritables failles avec rejets, comme en montrent les fers de Mukerop (Afrique Australe) et d'Arispe (Sonora), j'ai en vue des masses, d'apparence continue à l'œil nu, et dont la structure est cependant comparable à celle de nos roches cristallophylliennes.

Telle est la syssidère de Kodaïkanal (Indes Anglaises) dont le témoignage est probant. L'expérience de Widmanstatten y fait apparaître une structure que M. le docteur Latteux a rendue plus facile à interpréter par des photographies à 25 diamètres. Elle consiste dans un agrégat, ou brèche, de grains métalliques empâtant des enclaves lithoïdes, dont nous ferons abstraction. Les grains métalliques appartiennent à deux espèces, lithologiques bien caractérisés par la disposition relative des alliages, ou sidéronickels, qui y sont associés et qui manifestent de toutes parts des déformations internes rappelant celles que le martelage ou le laminage infligent aux fers météoriques préalablement chauffés. Ces déformations sont pour nous des stéréogrammes des compressions et des étirements éprouvés, que fait ressortir leur liaison intime avec un réseau de micro-fissures rappelant de très près celui des roches terrestres décrit précédemment. Le plus souvent courbes et anastomosées de la façon la plus capricieuse, elles sont tantôt fines et seulement remplies de matériaux charbonneux, graphite ou cohénite, tantôt plus larges et occupées par des veines complexes et rubanées. Les

délinéaments, rendus visibles sur les sections polies par l'action des acides, nous font assister à toutes les étapes de la désorganisation mécanique des "figures" et nous permettent d'imaginer dans les grandes lignes l'allure du broyage orogénique.

J'arrêterai ici, pour ne pas abuser de la bienveillance de l'illustre Academy of Natural Sciences of Philadelphia, la série des faits qui appuient la conclusion de mes études sur les actions mécaniques dont l'épaisseur de la croûte planétaire est le théâtre d'une manière ininterrompue. Comme on vient de le voir, les effets en sont prodigieusement différents par leurs dimensions d'un point à un autre, depuis le charriage en masse dont le massif du Mont-Blanc tout entier parait ne représenter qu'un résidu fort diminué, jusqu'au craquellement presque moléculaire, en tout cas microscopique, des éléments minéralogiques des roches de tous âges et de toutes catégories, qui parviennent progressivement à la condition cristallophyllienne.

L'admission de l'activité mécanique parmi les facteurs essentiels de la vie planétaire, est d'autant plus nécessaire que la cause même de cette dépende d'energie éclate à nos yeux avec plus d'évidence. Le refroidissement spontané dû noyau terrestre ne peut pas se poursuivre sans déterminer le retrait, à tendance centripète mais à manifestations tangentielles, qui refoule sans relâche la croûte à peine formée. Les conséquences de ce remaniement n'acquièrent la totalité de leur signification qu'au prix de la collaboration des pressions engendrées par le réchauffement souterrain de régions rocheuses, préalablement pourvues, comme on l'a dit, de matériaux élastiques qui savent faire de celles-ci, par l'élévation de leur température, des agents d'actions mécaniques centrifuges.

Ces travaux se réalisent selon un mode opératoire harmoniquement

MOLLUSCA OF THE SOUTHWESTERN STATES, VII: THE DRAGOON, MULE, SANTA RITA, BABOQUIVARI, AND TUCSON RANGES, ARIZONA.

BY HENRY A. PILSBRY AND JAMES H. FERRISS.

This paper and the preceding one (VI) contain the account of mollusks collected in course of our explorations in 1910, from the middle of August to the middle of October. The forms obtained in the Santa Catalina Mountains will be described in connection with the collections made there by one of us (Ferriss) in 1913. We were ably assisted in the field by Mr. L. E. Daniels.[1] Besides the ranges enumerated in the title, some account is given of several minor hill groups, all in the region south of the Southern Pacific Railroad. While this paper, with those already published on the Chiricahua and Huachuca Ranges, is monographic for the mollusks of Arizona south of the Southern Pacific, yet the field is far from exhausted. Our work is a reconnaissance rather than a complete malacological survey. Further species will reward search in the southwestern end and outliers of the Chiricahuas, the southern Dragoons, the Whetstone Range, and the mountains around and south of Tombstone. Further west we have explored only small middle sections of the Santa Rita and Baboquivari Ranges. Many hill and mountain groups between Tucson and Nogales remain untouched, most of them doubtless inhabited by endemic species of Sonorella. In the nearly waterless region westward between the Baboquivari Range and the Colorado River, almost nothing has been done aside from some account of the snails of the Comobabi Mountains, which we are now giving.

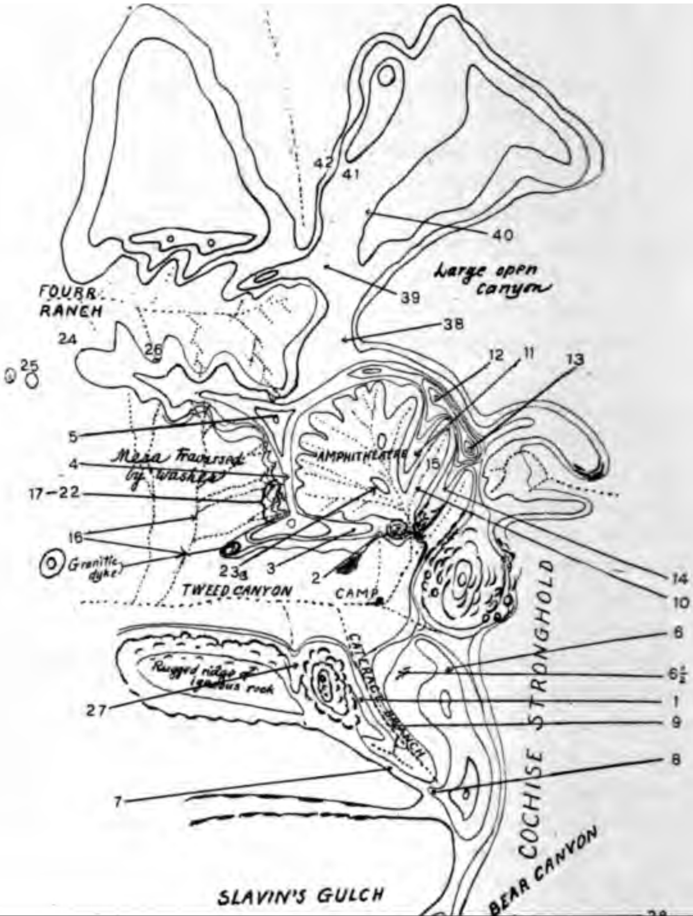
Going westward in southern Arizona from the eastern limit of the State, the general level falls and the mountains become lower and smaller. There is a gradual elimination of snails requiring a reasonable degree of humidity. *Ashmunella* and *Oreohelix* extend west to the Huachucas. Beyond that range they disappear. The small shells also abruptly diminish in number of genera and species, by

[1] We are indebted to Mr. J. C. Blumer, of Tucson, for several species from the Comobabi and Cababi Mountains, which we did not visit.

elimination of the Transition Zone forms. *Holospira,* too, becomes rare. In the Santa Cruz River Valley it is known by one species—at the present time, one specimen; and none are known from further west. The spread of this genus is not controlled by humidity. It lives in the driest and hottest situations, often at low elevations, but it is confined to limestone tracts, and limited by volcanic or metamorphic rock. The mountains westward, in the region under consideration, are mainly volcanic, and the stony tracts are therefore unsuitable for *Holospira.*

The progressive impoverishment of the fauna leaves, in the Santa Cruz Valley and westward, a few Lower Sonoran *Pupillidæ, Zonitidæ, Thysanophora* (*hornii*), and the true desert snail, *Sonorella. Sonorella* will live in the most arid places, where the rainfall does not exceed 5 or 6 inches, so long as there is abundant rock shelter and a certain amount of shade, such as the shadow of a cliff or a small bush. Northern slopes are preferred. In exploring a new mountain or hill in the really arid country one aims for the northern or northwestern slope under the highest crags. If coarse talus or rock "slides" are found, persistent quarrying should produce *Sonorella.* In less arid mountains, such as the Santa Ritas, the most productive collecting stations are in the deep, verdant canyons.

The exact location of collecting stations, and especially of type localities, which we attempt in these papers, may seem meticulous to many zoologists. In humid areas, or in dealing with less sedentary animals, such exactness would hardly be worth while; if a type locality is fixed within a few miles, it is near enough. But here we deal with a region of intense local differentiation and with creatures which are often confined within narrow bounds by physical conditions.


42
41
40
Large open canyon
39
38
FOUR R. RANCH
24
25
26
12
11
13
5
Mesa Traversed by washes
AMPHITHEATRE
15
4
17–22
16
Granitic dyke
23
3
2
14
10
TWEED CANYON
CAMP
COCHISE STRONGHOLD
6
$6\frac{1}{2}$
Rugged ridge of igneous rock
27
1
9
8
7
BEAR CANYON
SLAVIN'S GULCH

The fauna of this small range is strongly individualized, since all of the Holospiras and larger Helices are very distinct from species of other ranges, even the Sonorellas having well-defined conchological features. Like the Huachucas, there is (or was) an *Oreohelix* of the *strigosa* group, but hairy forms and the *Radiocentrum* group are wanting. The minute shells are all species common to the Chiricahua, Huachuca and other larger ranges, but the Transition and Canadian Zone species are very sparsely represented by *Pyramidula cronkhitei*, *Cochlicopa lubrica* and *Vertigo coloradensis arizonensis* only. Otherwise the fauna is purely Lower Sonoran.

The collecting stations are as follows:

Station 1. Slide of heavy, angular rock on west side of cataract branch of Tweed Canyon, below the crags of this side.

Station 2. Near the foot of small ravine next west of the granite defile forming the outlet of the Tweed amphitheatre.

Station 3. Near and at top of ridge above Station 2.

Station 4. Rim of amphitheatre, western side.

Station 5. Immediately north of small peak at N. W. of amphitheatre.

Station 6. Crag about half way up mountain on east side of cataract branch, overlooking part of Cochise Stronghold.

Station 6½. West of Station 6.

Station 7. Limestone ridge at the head of Cataract Branch.

Station 8. Higher up on the same ridge eastward.

Station 9. East side of the rocky bed of Cataract Branch, near the foot of the (dry) "falls."

Station 10. Bottom of eastward ravine in Tweed amphitheatre.

Station 11. Part way up ridge northwest of 10.

Station 12. High peak at summit of preceding ridge.

Station 13. High peak southeast of 12.

Station 14. Middle of ridge running from 13 to mouth of amphitheatre.

Station 15. Near bottom of ravine north of 14, and further up than 10.

Station 16. Arroyo in mesa in the mouth of Tweed Canyon.

Station 17. Third small ravine west of the large granitic spur in Tweed Canyon.

Station 18. Above Station 17, and separated from it by granitic dyke about 50 yards wide.

Station 19. Below Station 17.

Stations 20–22. Second ravine from large granitic spur in Tweed Canyon.

Station 22*a*. Second ravine west from Station 2, lower part of mountain.

Station 23. Second ravine west from Station 2, near summit of ridge. This station and the preceding one were not visited by

Pilsbry and are not plotted on the map. They are believed to be east of the granitic spur (dyke) on the north side of Tweed Canyon.

Station 23*a*. Small hill in bottom of Tweed amphitheatre near an abandoned arrastra.

Station 24. Gully on mesa, running westward out of Fourr ranch.

Station 25. Foothill west of Fourr ranch.

Station 26. Gully at south fence of Fourr ranch.

Station 27. First ravine west of Cataract Branch in the igneous southern side of Tweed Canyon.

Station 28. Bear Gulch, half way down.

Station 29. Bear Gulch, near its head.

Station 30. Ridge west of Bear Gulch.

Stations 31, 32. East side of Soren Gulch.

Station 33. West side of Soren Gulch.

Station 34. Small limestone hill in Middlemarch Canyon.

Station 35. Cochise Peak.

Stations 36, 37. Small limestone hills eastward on mesa at mouth of Middlemarch Canyon.

Station 38. North side of north ridge of Tweed amphitheatre, ¼ mile west of Signal Peak.

Stations 39–42. Successive stations between the northern crest of Tweed amphitheatre and the northern foothills of the range.

HELICIDÆ.

Sonorella ferrissi Pilsbry, n. sp. Pl. VIII, figs. 3, 3*a*, 3*b*.

The shell is strongly depressed, umbilicate (the width of umbilicus contained six times in the diameter of the shell), rather solid; of a pale brown tint, between cinnamon and wood-brown, fading around the umbilicus, having broad white bands above and below the narrow chestnut-brown shoulder band and crossed by one or several whitish streaks, reminiscent of former peristomes. The surface is semimat. The initial one-fourth whorl is smooth; a brief stage of

Height 7, diam. 14.2 mm.; 4½ whorls.

Genitalia (Plate XI, figs. 3, 3*a*).—The penis is somewhat slender, slightly shorter than the vagina, and a trifle longer than the epiphallus. It contains a cylindric papilla nearly as long as itself, transversely wrinkled in the distal third and rounded at the end (fig. 3*a*). The retractor muscle is inserted on the epiphallus near its base. *There is no flagellum.* Length of penis 4 mm.; penis-papilla 3+ mm.; penial retractor 6 mm.; epiphallus 3+ mm.; vagina 5½ mm.

Dragoon Mountains, from the northern ridge of Tweed Canyon to the ridges facing the northern slope of the mountains; types No. 103,097, A. N. S. P., from Station 38. Also taken at Stations 3, 4, 5, 10, 12, 13, 14, 15, 21, 22, 38–41.

The shell in this extremely distinct species reminds one a little of *Trichodiscina*. There is no other *Sonorella* like it. The embryonic sculpture is a modification of the *hachitana* pattern. In the genitalia it resembles *S. bicipitis* of the Dos Cabezas range as much as anything. It is abundant in the northern part of the Dragoon Range, but Tweed Canyon apparently forms an impassable barrier to its spread southward.

We rarely found *Sonorella ferrissi* sealed to stones, forming small rings. Most living ones were seen loose under stones or in the earth, lying with the aperture up, like Eastern Helices, and sealed with a somewhat convex white epiphragm. It belongs exclusively to the limestone terrain.

Sonorella dragoonensis n. sp. Pl. VIII, figs. 1, 1*a*, 1*b*.

The shell is rather depressed, umbilicate (the umbilicus contained 6½ times in diameter of the shell), thin, somewhat translucent, pale buffy brown, with whitish bands on both sides of a chestnut-brown band at the shoulder. The spire is low, conic, whorls 4¾, moderately convex. First one-third whorl smooth, followed by a brief stage of coarse radial wrinkles, continuing longest near the lower suture, and succeeded by papillæ and short, vermiculate radial wrinkles, interrupted by short wrinkles in a spiral direction, which on the lower part of the whorl bear epidermal bristles, beginning on the latter half of the first whorl, and continuing throughout the embryonic and neanic stages as far as the end of the third whorl. It is succeeded by an excessively minute vermiculate sculpture, which rapidly becomes fainter and disappears on the last two whorls, which are glossy and nearly smooth except for faint growth lines. Last whorl wide, descending in front. Aperture very oblique, round-oval. Peristome thin, very narrowly expanded throughout,

a little recurved below; the margins approaching, parietal callus short, thin except in old shells.

Alt. 11.25, diam. 19.5, alt. aperture 10.5, diam. 9.25 mm.
" 12 " 20.5, " " 11, " 9.25 "

Back dusky, tentacles dark, sole pale yellowish, with faint longitudinal lines, demarking the areas, near the tail.

Genitalia (Pl. XI, figs. 4, 4*a*, No. 103,093, from Station 29).—The penis is large, cylindric, encircled by a small muscular sheath at the contracted base, its retractor muscle inserted upon the apex of the penis and the base of the epiphallus. The walls of the penis are thin. Papilla (fig. 4*a*) nearly as long as the penis, stout, cylindric, having obliquely longitudinal corrugation near the end, the apex being obtusely conic with terminal pore. The flagellum is longer than usual. Epiphallus is about equal to the penis in length. The vagina is decidedly shorter than the penis. The duct of the spermatheca is very long.

Length of organs in mm.:

No. 103,093.—Penis, 10; epiphallus, 10; flagellum, 1.3; papilla, 8; vagina, 6; spermatheca and duct, 39.

No. 103,094.—Penis, 11; epiphallus, 9; flagellum, 1.3; papilla, 7.5; vagina, 7.

The jaw is highly arched, with five broad, unequal ribs.

Dragoon Mountains. Types from Station 28, Bear Canyon, No. 103,094, A. N. S. P., collected by Ferriss and Daniels, November, 1910. Also at Station 29, south of the Huzzar Mine, in the same vicinity.

This species is related to Dos Cabezas species by the position of the insertion of the penis-retractor, the cylindric penis-papilla and the short vagina. It differs from all of these in its very large and

Sonorella apache n. sp. Pl. VIII, figs. 2, 2a, 2b.

The shell is depressed, with low, conoidal spire, umbilicate (the width of umbilicus contained nearly 9 times in the diameter of the shell), extremely thin; mat isabella color above, paler below, glossy and diaphanous in the central half of the base, encircled by a narrow chestnut-brown band above the periphery. Whorls 4½, the embryonic shell comprising 1½; sculptured like that of *S. dragoonensis*. The neanic whorls are very minutely crinkled and closely set with short bristles in irregular oblique lines. About 110 of these bristles stand on one square millimeter, on the upper surface of the last whorl in front of the aperture. The bristles are rather delicate on the last whorl, and in cleaning the shell they are likely to be removed in large part. The last whorl is wide and descends rather deeply in front. The aperture is very oblique, subcircular. Peristome thin, the upper and outer margins very narrowly expanding, basal margin slightly recurved, columellar margin dilated, running forward. The ends of the peristome converge strongly, and are connected by a very thin, short, parietal film.

Alt. 10.25, diam. 16.8, width of umbilicus 1.9, aperture 8.5 x 9.7 mm.
" 10 " 17 mm.

Genitalia (Pl. XI, figs. 5 to 5c).—The penis is short and very thick, cylindric, obtuse at the ends, much shorter than the vagina. It has very thin walls, and is filled by a thick, fleshy papilla (fig. 5a). This is thick-walled with a rather large cavity having plicate walls so that it is star-shaped in section (fig. 5b). At the upper end of its cavity there is a short, conic nipple (fig. 5c); at the distal end of the papilla the cavity opens by a transverse slit. The retractor muscle of the penis is inserted on the epiphallus near the penis. The epiphallus passes imperceptibly into the vas deferens. *There is no flagellum.* The lower end of the vagina is swollen, having thick, fleshy walls. The organs measure as follows: Penis 7, penis-papilla 5, retractor muscle 8, vagina 11 mm.

Dragoon Mountains, the types from the southern or Cataract branch of Tweed Canyon, at Station 9, on the east side of the rocky bed near the foot of the "falls," No. 111,529. Also found at Station 1, a large slide of heavy, angular stone further north on the same branch, rather high on the west side of the ravine, under the great crag. A few dead shells were found at Station 27, in a gulch of the rugged south wall of Tweed Canyon, and at Station 10, on the eastern ridge of the amphitheatre of upper Tweed Canyon.

This species is somewhat related to *S. dragoonensis*, but differs by its smaller size, thinner shell, decidedly smaller umbilicus, and by having the last whorl densely hairy, the hairs extremely short and close. *S. apache* differs from *S. dragoonensis* rather conspicuously in soft anatomy. The penis is shorter with a differently constructed papilla; there is no flagellum; the vagina is much longer and is strongly swollen at the base. The anatomical characters of both have been examined in several specimens from different stations.

The delicately hairy periostracum will serve to separate *S. apache* from other species of the genus. It is an extremely distinct species.

Its home is among the great crags around Cochise Stronghold, a favorite resort of the Apaches. Station 10 is some miles northward of the other stations and at a somewhat greater elevation.

S. apache was found only in igneous or metamorphic rock, never in the limestone. It was not found sealed to the rock, nor were any white circles seen on the rocks it inhabits, thus differing from nearly all other Sonorellas collected by the authors.

Other specimens, from Station 1, measure:

Alt.	10.5,	diam.	17.5	mm.
"	11,	"	17	"
"	9.2,	"	15	"
"	8.8,	"	14	"

Station 1 is conspicuous from the hillside on the east side of the mouth of Cataract Branch, as a long, bare streak in the dense brush which clothes the slope below the crag at the west side, some distance up the ravine, and rather high on the side. One living shell and numerous "bones" were found by quarrying in the heavy rock of the slide. More living shells were taken at Station 9, the type colony.

As we searched the range carefully for *Oreohelix* after finding one on the first day, it is probably extinct, not surviving the destruction of the woods. There remains a possibility that it may survive in some part of the mountains not covered by our collecting stations.

Thysanophora hornii (Gabb).

Stations 2, 3, 6, 6½, 10, 11, 18, all in the limestone region north of Tweed Canyon.

UROCOPTIDÆ.

Holospira is rarely if ever found on igneous or metamorphic rock; and as the Dragoons are traversed by many dykes, the limestone areas where Holospiras live are divided by tracts barren of these snails. This has resulted in the differentiation of several species which though variable do not intergrade, so far as we know. In the Hacheta Range the limestone is continuous, and while there has been a good deal of differentiation, the several extreme forms are connected by those intermediate in structure and location.

It must be admitted that our knowledge of the Dragoon Holospiras is fragmentary. The whole foothill region, where they abound, needs attention. They are easily found, and in large numbers.

Holospira danielsi n. sp. Pl. XIV, figs. 1 to 3*a*.

The shell is cylindric, the upper fourth (or third) tapering to the slightly mamillar, obtuse summit. Tilleul-buff, becoming darker towards the summit. Nearly 2½ embryonic whorls are smooth; then slightly retractive axial ribs appear, rather low and delicate on the first neanic whorl, after which they become strong, widely separated, oblique (retractive) on the conical portion, still more widely spaced and vertical on the cylindric portion of the shell, where the summits of the ribs are more or less irregular from breakage due to being in part hollow there. On the penultimate whorl there are 13 ribs (more or less). On the last half of the last whorl the ribs become closer (or many may be interposed). The whorls are rather strongly convex, the last one tapering downwards, being compressed below the periphery; base rimate but not perforated. The last fourth of the last whorl is somewhat straightened but not built forward beyond the level of the ventral face of the shell. Aperture rounded-ovate. Peristome narrowly expanded except at the upper outer angle, where it is simple and obtuse. The axis is rather slender, subequal except at the ends. In the last part of the penult and first part of the last whorl there is a strong, short, obtuse columellar lamella close to the base; a parietal lamella, much longer and usually strong (and frequently a smaller basal lamella).

Length 11.5, diam. 3.5 mm.; 12½ whorls.

Dragoon Mountains, Cochise County, Arizona, from Tweed Canyon to the northern end of the range, on limestone, under stones, dead agaves, sotols, etc. Type locality Station No. 2, Tweed Canyon, No. 112,199, A. N. S. P.

They live on the most exposed, hottest slopes, often in great profusion, but are not found on the mesa, where *H. campestris* occurs.

This beautiful snail is very distinct from all of our species by its strong, rude, widely spaced ribs. One of the northwest Mexican Holospiras, *H. minima*, has the same type of sculpture, though less coarse than in the typical *H. danielsi*, which is the most strongly costate species known.

Like other Arizonian Holospiras, the internal lamellæ are variable, two or three (parietal and axial, or parietal, axial and basal) being developed. Otherwise the chief variation is in the number of ribs, and also in size.

Twenty specimens of the type lot, opened, taken at random, measure as follows:

Length	12,	diam.	3.6	mm.;	whorls	13;	lamellæ	2.
"	11.7,	"	3.7	"	"	13;	"	3.
"	11.5,	"	3.4	"	"	12½;	"	3.
"	11.3,	"	3.3	"	"	12½;	"	2.
"	11.2,	"	3.5	"	"	12;	"	3.
"	11.1,	"	3.3	"	"	12;	"	2.
"	11,	"	3.8	"	"	11½;	"	3.
"	11,	"	3.4	"	"	12½;	"	3.
"	11,	"	3.3	"	"	12;	"	3.
"	11,	"	3.3	"	"	12½;	"	2.
"	11,	"	3.3	"	"	12;	"	3.

The sculpture is less variable in this lot than in some others. Ten specimens, taken at random, have 10, 12, 12, 13, 13, 13, 15, 17, 17, 17 ribs on the penultimate whorl. These fairly represent the lot, so far as can be told without extensive counting. None counted have more than 17 ribs (see Pl. XIV, figs. 1, 1*a*, 1*b*).

Station 3 (summit of ridge above Station 2), but west of where the trail crosses ridge). Shells exactly like those of Station 2, but perhaps a little more variable in size, length 9 to 12½ mm. in extreme specimens.

Station 4 (summit of ridge further northwest, several hundred feet higher than Station 3). These shells are conspicuously larger than at Stations 2 and 3. Part of the shells are typical in sculpture, but in most of them the ribs are much *more numerous*, *closer*, *smooth*, and more regularly spaced. These close-ribbed shells agree with those from Station 5 and from Station 12, a peak on the opposite (east) side of the rim of the amphitheatre of Tweed Canyon. Probably the close-ribbed type of shell extends around the whole rim from Station 4 to Station 12.

Two out of fifteen opened have 3 lamellæ (both having many ribs), and three have only the columellar lamella (ribs few). The rest, including both many- and few-ribbed shells, have 2 lamellæ. This lot was picked up in several places along the summit of the narrow ridge, perhaps in an area of 20 x 100 yards. It therefore may comprise several colonies, and we cannot now tell whether fine- and coarse-ribbed shells occur actually together or not. There may be 12–15 ribbed colonies and 20–30 ribbed colonies, or possibly both sorts may live together. The measurements give extremes of size and are from "selected" shells.

Length	12.5,	diam.	4.1	mm.;	whorls	12¾;	lamellæ	3;	ribs	21.
"	12.3,	"	4	"	"	12½;	"	2;	"	24.
"	12.3,	"	4	"	"	12¾;	"	1;	"	15.
"	12,	"	3.9	"	"	12½;	"	2;	"	14.
"	11.8,	"	4	"	"	11½;	"	1;	"	22.
"	11.8,	"	4	"	"	12;	"	2;	"	25.
"	11,	"	3.8	"	"	12;	"	2;	"	13.
"	11,	"	4	"	"	11¼;	"	2;	"	24.
"	10.7,	"	4	"	"	11½;	"	2;	"	30.
"	10.2,	"	3.5	"	"	11½;	"	1;	"	12.
"	9.5,	"	3.5	"	"	11;	"	2;	"	15.

Station 5 (north of summit of peak north of Station 4). Shells are like the fine-ribbed ones from Station 4. No really coarse-ribbed forms were taken. Extreme and average shells measure as follows:

Length	12.3,	diam.	4	mm.;	whorls	12¾;	lamellæ	1;	ribs	27.
"	11.5,	"	3.7	"	"	11⅓;	"	2;	"	16.
"	11.3,	"	3.9	"	"	12½;	"	1;	"	29.
"	11.2,	"	4	"	"	12;	"	2;	"	38.
"	10.8,	"	4.2	"	"	11⅓;	"	2;	"	16.
"	10,	"	3.9	"	"	11½;	"	1;	"	21.

Station 18 (Pl. XIV, figs. 3, 3*a*). In the third ravine west of the granitic spur on north side of Tweed Canyon, above a dyke of igneous rock about 50 yards wide. Below this dyke, at Station 17, ***Holospira campestris cochisei*** is found. A deep gulley or "wash" extends from the ravine upon the mesa. The shells at Station 18 are a little more finely ribbed than typical *H. danielsi* and to that extent approach *H. campestris cochisei*. Out of 16 opened, 9 shells have 3, and 7 shells have two internal lamellæ. Measurements follow.

Length	11.3,	diam.	4	mm.;	whorls	12⅓;	lamellæ	2;	ribs	22.
"	11.3,	"	3.7	"	"	12;	"	3;	"	28.
"	11,	"	4	"	"	11;	"	2;	"	13.
"	11,	"	3.9	"	"	12½;	"	2;	"	16.
"	10,	"	3.5	"	"	11;	"	2;	"	22.
"	10,	"	3.3	"	"	11½;	"	3;	"	26.
"	10,	"	3.3	"	"	11¾;	"	3;	"	18.
"	9.7,	"	3.5	"	"	11;	"	3;	"	22.
"	9.5,	"	3.3	"	"	11;	"	3;	"	21.
"	9.5,	"	3.2	"	"	11;	"	2;	"	28.
"	9,	"	3.3	"	"	10½;	"	3;	"	24.

Station 20 (mouth of the second ravine west of granitic spur, Tweed Canyon). Shells similar to the preceding lot.

Station 22 (bed of the same ravine several hundred yards above the mouth). Shells similar, but averaging larger, though some are equally small; lamellæ one or two.

Station 15 (further east on the same branch, a little higher). Rather stout shells, with the mouth built out shortly (nearly 1 mm.); about 15 ribs; lamellæ one or two. 12 x 4 mm.

Station 13 (eastern peak of the rim of Tweed Canyon). Fine-ribbed, like Pl. XIV, figs. 5, 5*a*.

Station 11 (steep, stony, arid, southern slope of ridge projecting into amphitheatre, vegetation xerophytic). The shells are greater in diameter than the types, very uniform in sculpture, having 16 or 17 ribs on the penultimate whorl, the peristome built forward further than usual in the type lot. 10.5 x 3.7 mm. axial or axial and superior lamellæ.

Another lot, taken a couple of hundred feet higher, are similar in form, sculpture and lamellæ; ribs 15 to 19.

Station 12 (peak on eastern rim of amphitheatre). The shells are larger than at the preceding stations, with *more ribs*, 26 to 28 on the penultimate whorl. Half of those opened have one, half two lamellæ, the superior lamella not very strong. These shells are like those from Station 4 and 5. See Pl. XIV, figs. 4 to 4*b*.

Length 13.7,	diam. 4.2 mm.;	whorls 13.	
" 12,	" 4 "	" $11\frac{3}{4}$.	

Station 40 (between crest and foothills, north end of the range). Stout, rather large shells, with a strongly developed columellar lamella only in several opened. 37 to 43 ribs, nearly or quite as wide as their intervals. (Pl. XIV, figs. 5, 5*a*).

Length 12.3,	diam. 4 mm.
" 10.5,	" 4.1 "

These shells have more ribs than any other colony of *H. danielsi*, and they may be referable to *H. campestris cochisei*. The shells are, however, larger than the latter, some of the ribs are broken down, as in *danielsi*, and the locality is distant from other known colonies of *H. c. cochisei*. Only a very small lot was taken, and, pending further collections, its identity may be left undecided.

Station 39 (between crest and foothills at north end of the range). Much larger than the typical form, stouter, with few, strong and widely separated ribs. Only the axial lamella developed. (Pl. XIV, figs. 2 to 2*c*).

Length 13.3,	diam. 4.8 mm.;	whorls 13;	ribs 15.
" 13.5,	" 4.5 "	" 12;	" 15.
" 14.5,	" 4.1 "	" $13\frac{3}{4}$	" 19.
" 11,	" 4.1 "	" $11\frac{1}{2}$;	" 13.
" 12.1,	" 4.1 "	" 12;	" 12.

Station 42 (further north than Station 39). Similar to the above, having the same rude sculpture, but a little smaller in the average, length 11 to 13 mm.

Station 41. Shells like Pl. XIV, figs. 4–4*b*.

Holospira campestris n. sp. Pl. XV, figs. 1, 2.

The shell is shortly rimate, cylindric, with very short terminal cone and mamillar apex. 2½ embryonic whorls smooth (the last half whorl very narrow), following whorls closely and finely striate, the striæ of the conical portion narrower, hence appearing more widely spaced than those of the cylindric portion, on which they are as wide as the intervals. On the penultimate whorl there are about 70 striæ. The last whorl is decidedly compressed below the periphery, tapering downwards, somewhat more coarsely sculptured on the latter part. It is shortly rimate and built forward shortly from the preceding whorl. All of the whorls are very strongly convex. The aperture is angular at the upper outer part, elsewhere rounded. Peristome narrowly expanded. Axis cylindric, in the latter part of the penultimate and first part of the last bearing a stout axial lamella. There is also a long and strong parietal or superior lamella, and sometimes a basal lamella. Length 11.5, diam. 3.7 mm.; whorls 12.

Mesa at western foot of the Dragoon Mountains at Station 26, along a "wash" or gulley at the south fence of the Fourr ranch, No. 112,214, A. N. S. P. Also Stations 24, 25, in the same vicinity, etc.

Other specimens of the type lot (Pl. XV, figs. 1 to 1*d*) measure as follows. All but one of the specimens opened have two lamellæ, one having three.

parietal lamella when present is very small, and most specimens lack it. They are very uniform in size and sculpture, in a long series taken.

Length	8.7,	diam.	3.2	mm.;	whorls	10;	lamellæ	1.
"	8.5,	"	3	"	"	10½;	"	2.
"	8.1,	"	3	"	"	10⅓;	"	2.
"	7.9,	"	3.2	"	"	9½;	"	1.
"	7.9,	"	3	"	"	9¾;	"	1.
"	7.5,	"	3.1	"	"	9⅓;	"	1.
"	7.5,	"	3.1	"	"	9½;	"	1.
"	7,	"	3.1	"	"	9;	"	

Holospira campestris cochisei n. subsp. Pl. XIV, figs. 6 to 8*b*.

Similar to *campestris*, but more slender, with fewer ribs (28 to 40 on the penultimate whorl, in the type lot), the intervals wider. Internal lamellæ *three*, the parietal *very long and strong.*

Length	10.5,	diam.	3.3	mm.;	whorls	12;	lamellæ	3.
"	10,	"	3.1	"	"	11½;	"	3.
"	9.8,	"	3.1	"	"	11½;	"	3.
"	9.7,	"	3.1	"	"	11;	"	3.
"	9.6,	"	3.1	"	"	11;	"	3.
"	9.3,	"	3.1	"	"	11;	"	3.
"	8,	"	3.1	"	"	10;	"	3.

Dragoon Mountains: along the sides of an arroyo or gulley on the mesa within the wide mouth of Tweed Canyon, Station 16; Types No. 112,219, A. N. S. P. Also Stations 17, 19–23, and 27, all in Tweed Canyon.

The type locality, Station 16 (Pl. XIV, figs. 7–7*f*), is on the sloping sides of the arroyo, which is about 15 feet deep, and meanders across the mesa. Near the mountain the gully deepens to 30–40 feet, the sides become subvertical, and *Holospira* disappears. The mesa is grassy with some bunches of bear grass. There are some small oaks, juniper, catclaw, etc., in the arroyo. The shells are found under dead sotol and sometimes stones, etc. They reappear just below the igneous dyke near the base of the mountain, Station 17, but do not cross the dyke. Several other arroyos in the same plain were not examined, and there are doubtless many *Holospira* colonies in the neighborhood.

Station 19, on the slope near foot of mountain, below the igneous dyke. The shells resemble types of *H. c. cochisei* except that they are more finely, closely ribbed, ribs 45 to 50 on the penultimate whorl. Ten specimens opened are trilamellate.

Station 20. Mouth of second ravine west from granitic spur.

Station 21, hillside, eastern slope of second ravine from granitic spur, up to about 600 feet above bed of ravine. The shells are variable, as would be expected in a lot gathered over a considerable area, having 35 to 50 ribs on the penultimate whorl. Out of 11 opened, one has 3 lamellæ, ten have two, superior and axial. (Pl. XIV, fig. 6.)

Station 22, in the bed of the same ravine. Shells having about 56 ribs on penultimate whorl. Eight opened have 3 very strong lamellæ.

Station 23. Between Stations 21 and 2, near top. Like the preceding, lamellæ 2 or 3.

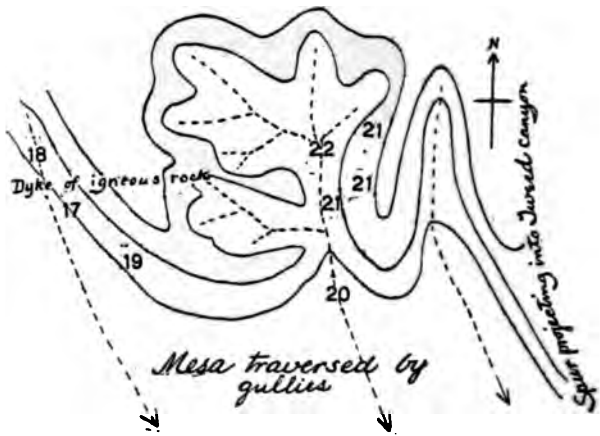


Fig. 2.—Sketch to show positions of collecting stations west of the spur in Tweed Canyon. Contour interval about 400 ft. The granitic dyke about 50 yards wide between Stations 17 and 18 separates colonies of *H. c. cochisei* (below) from those of *H. danielsi* (above).

whorls of the cone somewhat more sharply striate than the cylindric portion, upon which the striæ are very fine and close; typically about 90 fine, close striæ on the penultimate whorl. The latter part of the last whorl is slightly compressed and has slightly coarser, sharper striæ. The aperture is carried very shortly free, is not calloused within, and has a narrowly reflexed lip. Within the latter part of the penultimate and first part of the last whorl there is a rather stout, obtuse lamella on the axis. No lamellæ on the upper or basal walls of the cavity.

Length 12, diam. 4 mm.; 12 whorls.

Dragoon Mountains, south of Tweed Canyon, the types from Station 7, the summit of a limestone ridge separating the head of Cataract Gulch from the next canyon opening westward, south of Tweed Canyon, No. 112,225, A. N. S. P., collected by Ferriss, Pilsbry and Daniels, October, 1910. Also taken at Station 7, and Stations 29 to 37 southward from Stations 7 and 8.

H. millestriata is related to *H. campestris*, from which it differs by having more numerous, finer striæ, and by the absence of internal lamellæ on the parietal and basal walls of the cavity, in a long series of shells opened. Its range is separated from that of *H. campestris* by the ridge of eruptive rock which runs from Cochise stronghold along the south side of Tweed Canyon westward to the mesa; no Holospiras being found on this ridge, so far as we know. The isolation of the two species seems, therefore, to be complete. The species is quite constant in hundreds of shells collected from many colonies, as noted below; but in two stations in small hills on the mesa eastward of Middlemarch Canyon there is notable variation. Further study should be given to these small forms of the border between mountain and plain. In over a hundred shells opened from all the colonies, only one has a very weak trace of a superior lamella, all others having only a stout axial lamella.

The type locality, Station 7, is on the divide, a ridge above an abandoned mine and cabin. It may be reached by ascending Cataract Gulch from Tweed Canyon, but much more easily along the mountains eastward, as the gulch is rather a neckbreaker. The specimens are quite uniform in sculpture. Length up to 12.2 mm., and very rarely as short as 9.3 mm., with 10 whorls. (Pl. XV, figs. 3, 3*a*, 3*b*). Out of twenty opened, one has a weak, hardly perceptible trace of the superior lamella, the others having the axial lamella only. A series of 1000 or more was taken. It occurs under stones, etc., in places where there is no shade.

At the adjacent Station 8, eastward and slightly higher, the shells average smaller—about 10.5 mm. long—but are otherwise similar.

Station 29. Bear Gulch, near top, and Station 30, ridge west of Bear Gulch, typical shells.

Stations 31, 32, on the east side, and Station 33 on the west side of Soren Gulch, typical shells.

Station 34. A small limestone hill in Middlemarch Canyon. The shells have perceptibly coarser sculptures than in the types, about 70 riblets on the penultimate whorl. One internal lamella, the axial.

Station 35. Cochise Peak. Similar to the shells from Station 34.

Station 36. Small limestone hills eastward on the mesa of Middlemarch Canyon. The shells here are smaller than typical *millestriata*, and vary from the typical fine ribbing to somewhat coarser (Pl. XV, figs. 4, 4*a*, the prevalent form), and a few are as coarsely sculptured as *H. campestris cochisei*, the coarsest having 48 ribs on the penultimate whorl. The proportions of diameter to length also vary a good deal, as shown in the figures and measurements. All the specimens opened have a single lamella, the axial.

Length	9.5,	diam.	3.6	mm.;	whorls	11.
"	9.1,	"	3.3	"	"	10¾.
"	9.6,	"	3.1	"	"	11.
"	9.2,	"	3.5	"	"	10½.
"	8,	"	3.2	"	"	10.

Station 37. Another colony near the preceding, consists of very small shells. (Pl. XV, figs. 5 to 5*c*.)

Length 9, diam. 3.2 mm.; whorls 10½.

Zonitoides minuscula alachuana (Dall).

Dragoon Mountains: Stations 1, 6½, 10, 15, 26, 28, 29.

Striatura milium meridionalis P. and F.

Dragoon Mountains: Stations 1, 6, 10, 29.

Euconulus fulvus (Müll.).

Dragoon Mountains: Stations 1, 10, 15, 28 and *E. f. alaskensis*, Station 29.

ENDODONTIDÆ.

Pyramidula cronkhitei (Newc.).

Dragoon Mountains: Stations 28, 29.

Radiodiscus millecostatus Pils. and Ferr.

Dragoon Mountains: Stations 1 and 10; rare.

Helicodiscus arizonensis Pils. and Ferr.

Dragoon Mountains: Stations 1, 6½, 10, 28, 29.

Punctum californicum Pils.

Dragoon Mountains: Station 10, in the amphitheatre or upper basin of Tweed Canyon. The specimens are a little more openly umbilicate than the type, but the riblets are more unequal than in *P. pygmæum*, and spiral lines are scarcely discernible.

SUCCINEIDÆ.

Succinea avara Say.

Dragoon Mountains: Stations 2, 3; single dead specimens.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.).

Dragoon Mountains: Stations 1, 6, 6½, 10, 15, 28, 29. Abundant.

PUPILLIDÆ.

Bifidaria ashmuni Sterki.

Dragoon Mountains: Stations 1, 3, 6, 10, 11, 15, 25, 26, 29.

Bifidaria perversa Sterki.

Dragoon Mountains: Stations 2, 3, 22.

Bifidaria dalliana Sterki.

Dragoon Mountains: Stations 3, 6, 26.

Bifidaria pilsbryana Sterki.

Dragoon Mountains: Stations 1, 2, 10, 11, 15, 18, 25, 28, 29.

Vertigo coloradensis arizonensis P. and V.

Dragoon Mountains: Station 25.

VALLONIIDÆ.

Vallonia perspectiva Sterki.

Dragoon Mountains: Stations 1, 6, 10, 15, 25, 26, 28, 29. In copious numbers.

II. The Mule Mountains.

This group is between the southwestern outliers of the Chiricahua Range and the Huachucas, and is much lower than either, the highest summits about 7,000 feet. The greater part of the group is igneous rock, but the Escabrosa Ridge, running along the western and southern borders, is limestone. Collecting was done in the vicinity of Bisbee and Warren, August 29 and 30, 1910, by Daniels and Pilsbry. We found nothing in the igneous area, but *Sonorella* probably lives on the higher peaks.

The Geological Survey has published a topographic sheet of this region.

Sonorella bartschi n. sp. Pl. VIII, figs. 4, 4*a*, 4*b*.

The shell is strongly depressed, rather openly umbilicate (width of umbilicus contained nearly six times in the diameter of shell), moderately strong, though thin; color between cinnamon and wood brown, fading to white around the umbilicus, and encircled above the periphery with a dark chestnut band, bordered above and below with white bands, as wide as the dark band or wider. Surface glossy; initial $\frac{1}{3}$ whorl of the embryonic shell smooth; a few radial wrinkles follow, after which it has radial striæ which become more or less interrupted, forming irregular, long granules; beginning with the second whorl, there are short hairs, subregularly placed in forwardly descending rows; these continue to the penultimate whorl,

The penis is long, its lower half very slender, enveloped in a long sheath composed of glossy circular muscular tissue. The upper half is somewhat swollen. The penis-papilla (fig. 1*a*) is rather short, cylindric, very faintly wrinkled transversely, the distal end obtuse, rounded. The flagellum is about 0.8 mm. long. The vagina is about half as long as the penis. Other ♀ organs as usual in the genus (Pl. XI, fig. 1, from Station 1, near Bisbee, No. 103,095). Length of penis 14 mm.; epiphallus 11 mm.; penis-papilla about 5 mm.; vagina 7 mm.; spermatheca and duct 22 mm.

Mule Mountains: Mt. Ballard, in the Escabrosa Ridge; about 2 miles west of Bisbee, Arizona, on a ledge of the north side near the summit. Type No. 103,095, A. N. S. P., collected by Pilsbry, August 31, 1910. It was also taken on the northern slope of a limestone hill about two miles east of Warren, Arizona.

Other specimens from the type locality measure as follows:

Alt. 10.8,	diam.	20	mm.;	umbilicus 3.3 mm.;	whorls 4¾.
" 10,	"	18.8	"		whorls 4¾.
" 9.8,	"	18	"		
" 8.8,	"	17.5	"		
" 8,	"	16.4	"		
" 7.2,	"	14.5	"	umbilicus 2.9 mm.;	whorls 4½.
" 7,	"	14	"	" 3 "	" 4¼.

The shell is quite characteristic by its conspicuous white bands bordering the dark band at the shoulder, the rather open umbilicus, and the nearly circular, strongly oblique aperture. It is a handsome snail when fresh, not closely resembling any other species we have seen. Its nearest neighbor is *S. mearnsi* Bartsch, from San José Mountain, which lies just south of the international boundary near Naco, a railroad station on the El Paso and Southwestern R. R. *S. mearnsi* has a narrower umbilicus, less conspicuous white bands, only 4 whorls, the periphery of the last somewhat subangular, and the surface is very minutely granular.

The hairs of the neanic whorls are very delicate and fugacious; but when they are gone the spire still remains rougher than the last whorl, having an indistinct pattern of radial wrinkles or irregular, long granules. This disappears entirely on the last whorl. The embryonic whorl (beyond the initial half-whorl, which is alike in nearly all Sonorellas) is not marked with the protractive raised lines or series of granules of *S. hachitana* and its numerous group.

By its genitalia *S. bartschi* resembles the Chiricahuan *S. bowiensis*, but that differs by having close, finely developed sculpture of threads

forming tangents and V-shaped figures on the last embryonic whorl, as well as in various features of the adult shell.

We do not find in the shells of the Warren form any constant difference from those of the type locality; but the genitalia (Pl. XI, fig. 2) and jaw (Pl. XI, fig. 2*b*) differ somewhat in the only living adult taken. The penis has scarcely any sheath; only a few fibres bind the epiphallus. Flagellum more minute. Penis-papilla (fig. 2*a*) nearly half the length of the penis, tapering and wrinkled. The penial retractor is inserted on the epiphallus near its base. The vagina is nearly as long as the penis. Length of penis 10½ mm.; epiphallus 10 mm.; penis-papilla 5 mm.; vagina 9 mm.

The jaw (Pl. XI, fig. 2*b*) has about 5 weakly developed ribs.

Thysanophora hornii (Gabb).

Limestone hill 2 miles east of Warren.

Holospira arizonensis mularis n. subsp. Pl. XV, figs. 8 to 8*e*.

The shell is very shortly rimate, cylindric, with short terminal cone, wood brown or avellaneous, the last half of the last whorl opaque white; composed of 10½ to 13½ whorls, the first two smooth. The last half of the second and first half of the third whorl are narrower than the preceding and following whorls, as usual, and the apex projects somewhat nipple-like. Following whorls of the cone are quite convex, and are sharply, closely and obliquely striate. On the cylindrical portion the whorls are only weakly convex, and gradually lose the striæ, so that the penultimate and often one or two earlier whorls are smooth or nearly so, the last half-whorl becoming strongly, sharply striate again. The last whorl is compressed laterally on the back but becomes rounded near the aperture, pre-

Type No. 112,236, A. N. S. P., collected by Pilsbry and Daniels, August 29, 1910.

The Escabrosa Ridge, or mountain side on the left, ascending the first left-hand ravine above Bisbee on the Tombstone Road, is the home of this *Holospira*. Extensive burning of the brush has narrowed their range and decreased their numbers, at least for the time, so that the series collected was not large.[3] Some very small scrub oaks remain in places; there are three species of agave, some sotol and bear-grass, a few cylindropuntias, and many herbaceous plants, now after the summer rains gay with flowers; over everything a little scarlet morning-glory, which we afterward found common in the ranges westward.

Out of 20 shells opened, 18 have the axial lamella only; one has also a small superior or parietal, and one has superior and basal lamellæ, both very low and small.

This is a larger and longer species than *H. ferrissi*, and further distinguished by the smooth later whorls and deficient internal lamellæ. The Chiricahuan *H. arizonensis* Stearns differs chiefly by having the internal lamellæ larger.

Holospira ferrissi fossor n. subsp. Pl. XV, figs. 6 to 6b.

The short, cylindric shell is ribbed throughout, with about 47 ribs on the penultimate whorl. The last whorl is conspicuously flattened on the back, then gibbous (the gibbosity internally filled with white shelly material) and contracting to the aperture, the basal crest rather conspicuous. These features are more conspicuous than in *H. ferrissi*. There is an obtuse axial lamella in the front of the last whorl, and typically no other lamellæ; but three specimens out of 20 opened show a weak parietal lamella also. The color is wood brown or avellaneous, with the usual white patch on the last whorl.

Length	8.7,	diam.	3.3 mm.;	$10\frac{1}{3}$	whorls	(type).
"	6.4,	"	3.3 "	$8\frac{1}{3}$	"	(shortest shell).
"	9.8,	"	3.6 "	$10\frac{1}{2}$	"	(largest shell).
"	9.3,	"	3.3 "	$10\frac{3}{4}$	"	(slender shell).

Mule Mountains: on slopes of a limestone peak about 2 miles east of Warren, Arizona. Type No. 112,238, A. N. S. P., collected by Pilsbry and Daniels, August 31, 1910.

The town of Warren may be reached by a trolley line from Bisbee. It lies lower than Bisbee and is separated from the plain by a range

[3] 180 specimens in the lot taken by Pilsbry, probably as many or more taken by Daniels; most of them dead shells.

of hills which reach about 5,500 feet elevation. On the northern and northwestern slopes of one of these, about two miles east of the town, we collected *Sonorella*, *Holospira* and some smaller shells. *Holospira* is very abundant (over 1,500 collected by H. A. P.), living in mellow earth under stones, in "nests" of from six to twenty or more, usually standing vertically, apex up, and buried in earth up to the summit. While the sculpture of this species is coarser than that of typical *H. cionella*, yet there are some equally coarse individuals of the latter. It is quite possible that *H. cionella* may eventually be ranked as a subspecies of *H ferrissi*.

In the débris of the San Pedro River above the S. P. R. R. bridge, near Benson, Arizona, we found three specimens representing as many races of *Holospira*. One is the upper half of a slowly tapering species, evidently new. The others are probably races of *H. ferrissi*. One specimen has the appearance of a small *H. f. fossor*. It has the same sculpture, a low axial lamella, and measures, length 7.6, diam. 3.1 mm., $9\frac{3}{4}$ whorls.

The other shell resembles *H. ferrissi* in having three internal lamellæ, the superior and axial lamellæ being strongly developed. The ribbing is as fine as in the most finely ribbed *ferrissi*—decidedly finer than in *fossor*. The form is more slender than in *ferrissi*. This shell apparently represents another subspecies or local race of *H. ferrissi*. As it may have drifted a long distance, it had better be left nameless until found in its natural habitat.

Holospira ferrissi sanctæcrucis n. subsp. Pl. XV, fig. 7.

The shell is similar to the most slender and fine-ribbed examples of *H. ferrissi* in form and sculpture, except that the apical whorls are more mucronate. The three internal lamellæ are lateral in posi-

floated many miles, as the river merits that name in time of flood, though usually reduced to a chain of infrequent pools or an insignificant rivulet. The term river, in the arid belt, refers to the bed and banks rather than to the water, which is often conspicuous for its absence during a great part of the year.

ZONITIDÆ.

Vitrea indentata umbilicata (Ckll.).

Two miles west of Bisbee, and about the same distance east of Warren, on limestone hills, with *Holospira*.

PUPILLIDÆ.

Bifidaria pellucida hordeacella (Pils.).

Limestone hill about 2 miles east of Warren, Arizona.

III. Benson, Arizona.

Benson, Cochise Co., at the junction of the Southern Pacific and El Paso and Southwestern Railroads, is in a flat region, with no mollusk fauna in its immediate environs. The San Pedro River, flowing northward about a mile east of the town, brings down considerable flood débris containing shells. The source of these is probably in the foothills of the Whetstone Mountains, not far away; possibly also the hill country about Tombstone, or even further south.

The San Pedro carries more water than any other stream in the lower tier of counties between the Rio Grande and the Colorado, and so far as we know it is the only one maintaining a constant flow. At Benson it is a turbid stream 20 to 30 feet wide, with vertical, dirt banks about 8 feet high (September 1st), meandering in a flood plain covered with mesquite.

Mr. Ferriss collected a few shells from the river drift in 1904; and in 1910 Pilsbry and Daniels, having an hour or two between trains, collected a small bag of shell-bearing débris near the S. P. R. R. bridge. In this sample the most abundant mollusk is *Bifidaria procera cristata*. The small *Zonitoides*, *Bifidaria p. hordeacella*, *Pupoides marginata* and *Vertigo ovata* are next in abundance. All the species except *Vallonia gracilicosta* are Lower Sonoran forms.

Thysanophora hornii (Gabb).
Holospira ferrissi Pils. (variety). See p. 388.
" f. fossor P. and F. See p. 387.
" n. sp. (spire only).
Vitrea indentata umbilicata (Ckll.).
Zonitoides minuscula alachuana (Dall).
" singleyana (Pils).

Succinea avara Say.
Vallonia gracilicosta Reinh.
" perspectiva Sterki.
Pupilla blandi Morse (3).
" hebes (Anc.) (1).
" syngenes (Pils.) (½).
Pupoides marginata (Say).
" hordacea (Gabb).
Bifidaria procera cristata (P. and V.).
" pellucida hordeacella (Pils.).
" ashmuni Sterki. (1).
" perversa Sterki.
" pentodon (Say).
" tappaniana (C. B. Ad.).
" tuba P. and F.
Vertigo ovata (Say).
" milium Gld. (1).
Lymnæa parva Lea.
" bulimoides cockerelli P. and F.
Planorbis caribæus Orb.
" liebmanni Dkr.
" parvus Say.
" arizonensis Pils. and Ferr.[4]
Physa virgata Gld.
Amnicola sp. (two dead specimens).
Sphærium triangulare (Say).
Pisidium compressum Prime.

Vertigo milium, *Bif. tappaniana* and *Sphærium triangulare* (one valve) were obtained in 1904, not in 1910. The latter is new to the fauna of the United States, but having compared with the type specimens, we are satisfied of its identity.

Part of the specimens we refer to *Lymnæa parva* agree with cotypes

colonies were found near by. Our second camp was at the cabin in the saddle at the head of Agua Caliente Canyon, somewhat above 7,000 feet and close to collecting Station 6 of map. There is a good spring. The best collecting is in Walnut Canyon, Station 5, where three species of *Sonorella* live. From above this camp there is fine timber, but no land shells worth mentioning up to the summit of Mt. Hopkins. Good collecting stations were found in Madera Canyon which would be an excellent place to camp. We also reached the head of Josephine Canyon from this camp. A two-day excursion was made, via Brandt's mining camp, over the 8,500-foot saddle north of Old Baldy, and down Camperel Canyon[5] to perhaps 7,000

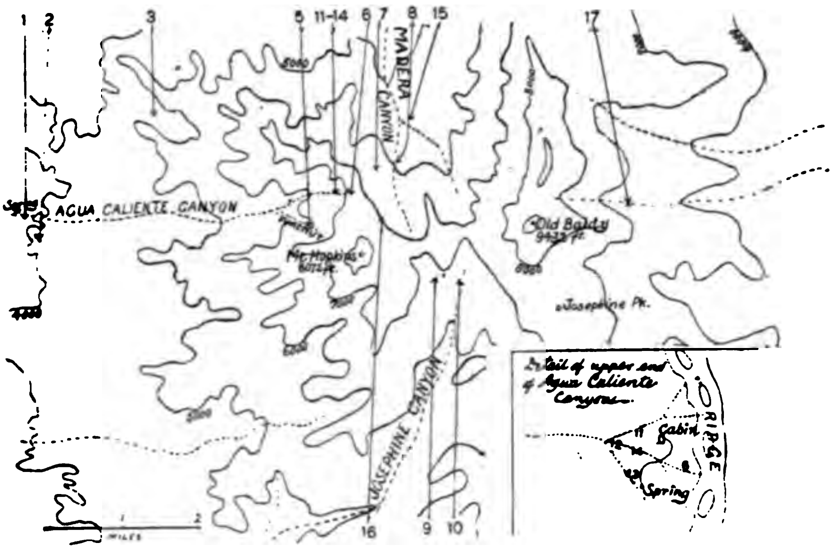


Fig. 3.—Collecting stations in the Santa Rita Mountains. Contour interval, 1000 feet.

feet. There is fine pine on the top and extending some distance down. Also some huge spruce and hemlock trees. We passed through aspens, then small-leaved maples, to walnuts, in the bed of the canyon. *Sonorella clappi* occurs here, and a few specimens of a *Sonorella (occidentalis)*, which we provisionally rank as a subspecies of the Huachucan *S. granulatissima*. It will be seen that our work extended nearly across the middle of the highest part of the range in a rather narrow band, the collecting stations being marked on the accompanying tracing simplified from the U. S. G. S. topographic map.

[5] This canyon is not named on the topographic map. On it Stetson's dam is situated, lower down.

The absence of the common western Sonorellas (*santaritana* and *walkeri*) on the eastern slope, and the occurrence there of another species (*S. g. occidentalis*) indicates a certain amount of local faunal differentiation, and it seems likely that work in the northern, southern or eastern parts of the range would result in a number of additional species of *Sonorella*. By the absence of *Oreohelix* and *Ashmunella* (in the parts we explored), the Santa Ritas differ remarkably from the Huachucas, the next range eastward.

We obtained very few small shells.

Vitrea indentata umbilicata (Ckll.), Stations 7, 12, 17.

Euconulus fulvus (Müll.), Station 7.

The locations of collecting stations follow.

Station 1. In rock along banks of stream flowing from Agua Caliente Canyon, immediately south of the spring.

Station 2. Northern base of bluff southeast of Station 1.

Station 3. About half way up "Soldier Canyon," a short canyon immediately north of the mouth of Agua Caliente.

Station 4. Pool of Agua Caliente Spring (*Physa humerosa* (?), frogs, etc. collected).

Station 5. Walnut Canyon or branch of Agua Caliente, which opens about 200 yards below the miners' cabin midway of A. C. Canyon. Shells abundant above and below the mine, in piles of heavy granite rock. None found in "Walnut basin" higher up.

Station 6. On the ravine south of cabin in the saddle, at head of Agua Caliente.

Station 7. Madera Canyon, about half way down the steep slope from camp.

Station 8. Madera Canyon, about 100 yards above "Old Johns Camp" in an extensive rock pile in the bed of the canyon, about 10 feet above the stream. This is opposite the saddle at head of [redacted]

Sonorella santaritana n. sp. Pl. IX, figs. 1 to 3.

The shell is depressed, umbilicate (the width of umbilicus contained between 6 and 7 times in diam. of shell), solid, between cinnamon-buff and pinkish-buff, becoming whitish on the base, and having a chestnut-brown shoulder band bordered with white.

The surface is rather glossy. Embryonic shell of 1½ whorls; after a very short initial smooth stage, the surface becomes radially rippled, then densely granular, the granules lengthened in an obliquely spiral direction, becoming longer with the growth of the embryo, the last ¾ whorl of the embryo marked with threads forming V-shaped figures, their intervals densely, subregularly wrinkled radially.

The post-embryonic whorls have very fine, inconspicuous growth lines and excessively faint spiral lines on the last whorl, above and at the periphery. The spire is very low conic. Whorls 4½, convex; the last descends deeply in front. The aperture is very oblique, small; peristome narrowly expanding, pale brown at the edge, the margins converging, so that the thin, transparent parietal callus is short. In the last whorl the umbilicus enlarges to about double its previous width.

Alt. 13, diam. 23, width of umbilicus 3.6 mm.; aperture 10.5 x 12 mm.

Santa Rita Mountains, Arizona, in Walnut Canyon (a branch of Agua Caliente Canyon) at about 6,000 feet elevation, Station 5, Ferriss, Daniels and Pilsbry, 13-IX-1910. Type No. 112,105, A. N. S. P. Also taken at Stations 11, 12, 13, 14, between 6,000 and 7,000 feet, near the head of Agua Caliente Canyon; Stations 7, 8, 16, in Madera Canyon, from about 5,700 to nearly 7,000 feet, and at Stations 9 and 10, in the head of Josephine Canyon, near the ridge connecting Mt. Hopkins and Old Baldy, at about 6,500 feet.

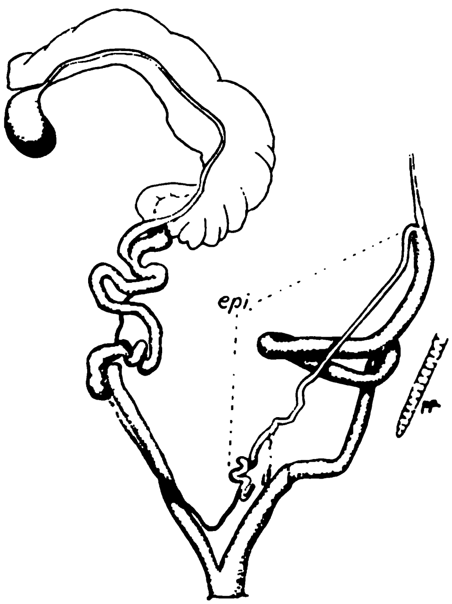


Fig. 4.—Genitalia of *S. santaritana*. *epi.*, epiphallus; *pp.*, end of the penis-papilla.

Genitalia (fig. 4).—The penis and vagina are extremely long. Penis is rather slender, and lies in three folds in the

body. It has a basal sheath, and a slender, conspicuously annulated papilla, one-third the length of the penis or longer. The flagellum is well developed for *Sonorella*. The penial retractor is inserted at the apex of penis and base of epiphallus. The vas deferens is slender throughout. Measurements of the organs in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Penial retractor.	Vagina.	Spermatheca and duct.	Diam. of shell.
5	33		22	1.5	14	29	28	23
5	40	13	27			34		22.3
12	27		26	1.8	15	33		23.5
9	31	12.5			18	36		20
10	41	17	18+	2	15	36	27	22.5

Specimens from Station 11, and numerous others from Station 5, opened but not measured, were sufficiently examined to show that the specific characters—great length of penis and vagina—are constant.

S. santaritana differs from other species of the same range by its *wider umbilicus*, the more approaching ends of the lip, and especially by *the great length of penis and vagina.* In the characters of the genitalia it is nearest to *S. rinconensis* P. and F. (these PROCEEDINGS for 1909, Pl. XXII, fig. 5). That species differs by having a still longer vagina, and a more capacious shell with larger aperture and relatively smaller umbilicus. *S. dalli* and *S. virilis* are somewhat related, but differ in characters of both genitalia and shell.

This is the most abundant and widely distributed *Sonorella* of the part of the Santa Rita Range which we explored.

fading to white around the umbilicus and on both sides of the chestnut-brown shoulder band.

The surface is glossy, lightly marked with growth lines, and under a strong lens showing impressed spiral lines on the upper surface of the last whorl (lacking, however, in many individuals). Initial $\frac{1}{3}$ whorl radially rippled, granulation then beginning, the last $\frac{2}{3}$ whorl having close protractively spiral threads, the intervals densely wrinkled radially. Spire very low conic. Whorls $4\frac{2}{3}$, the last descending in front. The aperture is rounded oval; peristome narrowly expanding, inconspicuously brown-edged, slightly thickened within, the margins converging, joined by a thin, brownish-edged parietal callus.

Alt. 14, diam. 23 mm.; umbilicus 2.6 mm.; aperture 12 x 13 mm.

Genitalia (Pl. XII, figs. 1–3, 5, 5*a*).—The penis is *small and slender*, at the base enclosed in a short but thick sheath. Penis-papilla cylindric, more than half the length of penis, tapering distally to a blunt or a somewhat pointed end. Retractor muscle inserted on the epiphallus near its base. Epiphallus as long as the penis or somewhat longer, terminating in a *minute, bud-like flagellum*. Lower part of the *vas deferens large*, its diameter equal to or exceeding that of the epiphallus. Vagina usually about twice the length of the penis.

Santa Rita Mountains, the type from Station 5, Walnut Branch of Agua Caliente Canyon, at about 6,000 feet, with *S. santaritana* and *S. clappi*, type No. 112,164, A. N. S. P., collected by Ferriss, Daniels and Pilsbry, 1910. Also taken at Station 3, "Soldier Canyon," at about 4,500 feet, and in Madera Canyon at Stations 7, 8 and 15.

This fine species, named for Dr. Bryant Walker, is not uncommon, though less generally distributed than *S. santaritana*. In the type locality it lives with *S. santaritana* and *S. clappi*, sometimes all under the same rock, sometimes in separate rock piles. The smallest specimens, Station 5, measure 20 mm. in diameter; the largest, Station 15, 24.3 mm.

Station 3 is in a small canyon running in north of the mouth of Agua Caliente, opening to the mesa between two high granite crags. The rock is a coarse granite, and shells are not numerous. A single giant cactus growing here is further east than we have seen the species elsewhere.

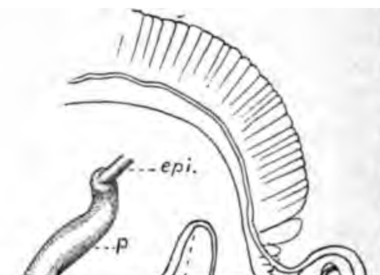
Many specimens have been dissected. The slender, short penis, with a short, thick basal sheath, and the enlarged free vas deferens

are conspicuous characters. The smaller umbilicus and less depressed contour separate it from *S. santaritana*, which also differs more fundamentally by its genitalia. *S. walkeri* is very much like *S. clappi* in soft anatomy. Its relation to *S. huachucana* Pils. remains to be defined when that species shall have been dissected. Measurements of the organs in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.
5	4.7	2.3	5	1	8	
5	5	3	5	Minute	7	
8	4	2.3	6	"	10	
15	4.3	2.8	7.3	"	10	
3	4	3	6.5	0.7	7.5	26
	7	5	6.7	Minute	7	

Sonorella walkeri aguacalientensis n. subsp. Pl. IX, figs. 5, 5*a*, 5*b*, 6, 6*a*, 6*b*.

A form with the shell not constantly distinguishable from *S. walkeri* was found in some abundance at Stations 1 and 2, in the mouth of Agua Caliente Canyon. Station 1 is in rocks on the bank of the wash running out of the canyon, immediately southeast of the fine spring of tepid water which gives this canyon its name. This is the



Station 2, at the base of bluffs southeast of Station 1 and somewhat higher, afforded a few similar shells (Pl. IX, figs. 5, 5*a*, 5*b*). One preserved in spirit differs from *S. walkeri* by having a decidedly longer penis, penis-papilla and epiphallus. There is no flagellum, and no penial retractor muscle was found. (Fig. 5.) These differences, if confirmed by further dissections, in our opinion, indicate a distinct species; but to direct attention to it we now rank the race as a subspecies of *S. walkeri*. The diameter at Station 2 runs from 22.3 to 24 mm. The elevation of this Station is between 4,100 and 4,200 feet, according to the topographic map.

Sonorella clappi n. sp. Pl. IX, figs. 8, 8*a*, 8*b*.

The shell is umbilicate (umbilicus contained about 8 times in the diameter), thin, depressed, semimatt, cinnamon, the base paler, fading to olive-buff in the middle, and with a chestnut-brown shoulder band having paler borders. Embryonic shell of 1¾ whorls, the initial ½ whorl smooth, the rest densely and evenly reticulate-granulous, having an indistinct zigzag pattern in some places, but without the spirally descending threads of the *hachitana* type. Subsequent whorls are lightly striate and microscopically wrinkle-granose, this sculpture becoming weaker on the base. Whorls 4½, the last descending in front, rounded peripherally. Aperture rounded-oval, the peristome thin, narrowly expanded.

Alt. 10.3, diam. 19 mm.; umbilicus 2.4 mm. (type).
" 10.3, " 18 " (globose topotype).
" 9, " 17.7 " (depressed topotype).

Genitalia (Pl. XII, figs. 6, 7).—Penis slender throughout, with a thick, short basal sheath and a long papilla. Epiphallus and vas deferens slender, the former terminating in a minute flagellum, the retractor muscle inserted close to its base. Vagina shorter than the penis. Measurements in mm. follow.

Station.	Penis.	Penis-papilla.	Epiphallus.	Flagellum.	Vagina.	Spermatheca and duct.
8	8.5	6	8.5	Minute	5	
12	6.5		8	Minute	3	25

Santa Rita Mountains: Station 8, Madera Canyon, type No. 112,163. Also taken at Station 16, Madera Canyon; 6, 12, 13, 14 near the head of Agua Caliente Canyon; abundantly at Station 5.

Walnut branch of Agua Caliente; and Stations 17 and 17½, Camperel Canyon, on the eastern slope of the mountains, at about 6,500 feet.

This is a smaller, thinner shell than other Santa Rita Sonorellas, and readily distinguished by its microscopic granulation and the beautiful sculpture of the embryo. It is variable in degree of elevation of the spire, size of umbilicus and color. In Madera Canyon the shell has a russet hue.

In Walnut Branch of Agua Caliente the color ranges from almost chamois in the thicker old individuals to nearly water green in those barely grown to full size. The microscopic granulation is sometimes typically developed on the last whorl, but more often more or less obsolete, sometimes only visible in a few places; and most specimens show incised spiral lines on the last whorl, occasionally quite distinct and numerous. Around the head of Agua Caliente Canyon the color is similar to the Walnut Branch lot.

S. clappi resembles the Huachucan *S. granulatissima* and *S. danielsi* in the embryonic sculpture and the general appearance, but in those species the aperture is more oblique than usual in *S. clappi* and the genitalia are conspicuously different. Having dissected a good many individuals of all of these species, I feel confident that the genitalia afford the most reliable specific characters. *S. clappi* is very much like *S. walkeri* in genitalia.

A couple of shells from Station 17½, Camperel Canyon, on the eastern slope of the range, resemble the Agua Caliente form in being light colored. One from Station 17, in the same canyon, is the darkest of all, being nearly a sorghum-brown color, more vinaceous where the cuticle is worn off. The genitalia (Pl. XII, figs. 4, 4a) differ from typical *S. clappi* by the longer penis and penis sheath,

Alt. 12, diam. 19.6 mm.; umbilicus 2.8 mm.; 4¾ whorls.

Santa Rita Mountains at Station 17 (Camperel Canyon), on the northeastern flank of Old Baldy. Type No. 112,165, A. N. S. P.

We regret that the jar containing the soft parts of this species proved leaky, and its contents were lost. It seems to be related to *S. granulatissima*, as the sculpture is very similar.

V. Small Ranges and Hills of the Santa Cruz River Valley.

Between Tucson and Nogales and the Santa Rita and Baboquivari Mountains there are many buttes and ranges of hills or small mountains, a few of which we visited, finding in each a special species of *Sonorella* and sometimes a few small shells.

Among the more important ranges which should be investigated we may mention the Tumacacori (or Atascoso) range, an extensive mass of arid looking mountains, extending south to the Mexican line, and probably supporting little but *Sonorella*. They are easily accessible from the Sonora R. R., being about 6 miles from "Siding No. 4." These mountains on the south pass into the Sierra de los Pajáritos, which lie west of Nogales—"a confused mass of rocky crags, peaks, flat-topped mountains with vertical sides, enormous trachyte dykes, steep narrow ridges and deep canyons." They are covered with "a fine growth of oak, juniper and manzanita, while magnificent walnut, sycamore and ash trees line the canyons." Water supply precarious except in the wet seasons. These fine mountains are unknown to the conchologist.

Various species reported from Tucson were certainly brought there from more or less distant localities. *Sonorella granulatissima*, reported by Bartsch, Smiths. Misc. Coll., Vol. 47, p. 193, and *Ashmunella varicifera* Ancey are Huachucan species. The following species were taken in the drift débris of the Santa Cruz River, near Tucson, chiefly above the bridge. The fresh-water shells are mainly fossils, washed out of, or exposed upon the low dirt banks, where the stream has cut down through a former *cienega*. Part of the land shells probably washed in from the Tumamoc and other eastern foothills of the Tucson Range. We found *Bifidaria tuba* and *Thysanophora hornii* on the Tumamoc Hills, and with other minutiæ, in débris washed down from the hills at the hill terminus of Congress St.

Thysanophora hornii (Gabb.).
Holospira ferrissi sanctæcrucis P. and F. (see p. 388).
Zonitoides singleyana (Pils.).
Succinea avara Say.

Pupoides marginata (Say).
Bifidaria procera cristata P. and V.
" pellucida hordeacella (Pils.).
" tuba P. and F.
Vertigo ovata Say.
Lymnæa parva Lea.
" obrussa Say.
" bulimoides cockerelli P. and F.
Planorbis tenuis Phil.
" caribæus Orb.
" parvus Say.
" arizonensis P. and F.
Physa virgata Gld.
Paludestrina protea (Gld.).
Pisidium pauperculum (Sterki).[6]
" compressum Prime (kirklandi Sterki).
Anodonta dejecta Lewis, fossil and recent, fragmentary.

In the drift débris of the Santa Cruz River at Amado's Ranch (not far from the mouth of Sopori Creek) we took the following:

Zonitoides singleyana (Pils.).
" minuscula (Binn.).
Pupoides marginata (Say).
Bifidaria pellucida hordeacella (Pils.).
" perversa Sterki.
" procera cristata P. and V. (one specimen).
" pentodon (Say).
Vertigo ovata Say.
Vallonia perspectiva Say.
Physa humerosa Gld.
" virgata Gld.

On Sopori Creek, five miles west of Amado's Ranch.

[redacted]

river valley, and will eventually be found again. Great quantities of the drift débris of the Santa Cruz which we looked over did not produce a second specimen, though minute shells were abundant. Only by a rare chance would so turbulent a stream as the Santa Cruz in flood carry *Sonorella* very far. In its ordinary condition there is a succession of small pools connected, in places, by a slender rivulet; but after heavy rain we have seen turbid water from bank to bank for a brief time.

Sonorella tumamocensis n. sp. Pl. X, figs. 4, 4*a*, 4*b*.

The shell is depressed, umbilicate (umbilicus contained about 6 times in the diameter of the shell), thin, light pinkish cinnamon, fading to whitish on the base, and having indistinct whitish borders above and below the rather narrow chestnut-brown shoulder band. Apical sculpture is of the *hachitana* type, but usually very weak, the initial half-whorl smooth, without the usual radial ripples; the rest of the embryonic shell is marked with a few delicate, interrupted tangential (protractive) threads, on a nearly smooth ground, having weak growth ripples only. The subsequent neanic and last whorls have weak growth lines. Whorls 4½, convex, the last slowly descending in front. Aperture rounded, nearly as high as wide. Peristome thin, the outer and basal margins very narrowly expanded. The columellar lip, in basal view, shows *very little dilation*.

Alt. 10.5, diam. 17.5 mm.; aperture 8.7 x 9.5 mm.; umbilicus 2.8 mm. wide.

Other specimens measure:

Alt. 10.5,	diam.	18 mm.
" 9,	"	17 "
" 9,	"	16 "

Genitalia (Pl. XIII, fig. 5).—The penis is about as long as the vagina, slender in its lower part, somewhat swollen above. Around the base there is a very short sheath of very loose open texture. It contains a slender, slowly tapering papilla about one-third as long as the penis, its surface *closely grooved spirally*, the apex obtuse but small. The epiphallus is slender, terminating in a vestigeal, bud-like flagellum. The retractor muscle is inserted on the epiphallus. Other organs as usual.

Top of the head and back are slate-colored, shading into gray on the sides, whitish towards the edges of the foot. Tail and sole white. Faint lines define the three areas of the sole. Jaw (Pl. XIII, fig. 8) has 3 or 4 very weak ribs.

Tumamoc Hill, near Tucson, Pima Co., Arizona. Types No. 112,245, A. N. S. P., collected by Ferriss, Pilsbry and Daniels, October 1, 1910; topotypes in collections of Ferriss and Daniels. Specimens were taken by Mr. J. C. Blumer under volcanic cliffs on the northeast side of Cat Mountain, in the Tucson Range.

The shell closely resembles *S. eremita* of the Mineral Hill group, but it is much thinner with the peristome decidedly less expanded and the embryonic whorls smoother. The penis is very much longer than in *eremita*. A comparison with the unique type of *S. arizonensis* Dall, kindly made by Dr. Paul Bartsch, shows that that species is quite distinct.

We would be disposed to consider *tumamocensis* a subspecies of *S. rowelli* were it not that in individuals having the shell about the same size as *rowelli* the penis, penis-papilla, epiphallus and vagina are about twice as long; the spermathecal duct remaining about equal in the two species. The shape of the penis-papilla is different, that of *tumamocensis* being longer, slender and tapering. For comparison we have added measurements of the organs of *S. rowelli* to the table on p. 408. The columellar lip dilates much less than in *S. comobabiensis* or *S. sitiens*.

The penis is very much longer, its papilla both absolutely and relatively much shorter than in *S. papagorum*.

The Tumamoc Hills are an outlying spur of the Tucson Range, about a mile from Tucson west of the Santa Cruz River. There are three hills: Tumamoc, 3,092 feet, on the northern slope of which the Desert Botanical Laboratory of the Carnegie Institution of Washington stands; Sentinel, 2,885 feet, and a lower nameless hill of 2,672 feet elevation. The hills are volcanic, formed of an old

Except for the specimens of *S. tumamocensis*, taken by Mr. Blumer at Cat Mountain, the Tucson Range, about 25 miles long, is not explored for shells.

Sonorella papagorum n. sp. Pl. VIII, figs. 8, 8*a*, 8*b*.

The shell is depressed, umbilicate (the umbilicus contained about 9 times in the diameter of the shell), rather thin, somewhat glossy, light pinkish cinnamon, fading to whitish around the umbilicus, and a trifle pale at the edges of a dark chestnut-brown band at the shoulder. Apical sculpture is of the *hachitana* type, but *very weakly* developed, the initial half-whorl smooth, the rest of the embryonic shell similar to that of *S. tumamocensis*. Subsequent whorls are lightly marked with growth lines. Whorls 4¾, convex, the last descending slowly in front. Aperture oblique, rotund-oval. Peristome slightly expanded above, the outer and basal margins well expanded, thin; columellar margin broadly dilated, partly covering the umbilicus.

Alt. 14, diam. 23 mm.; aperture, alt. 11.8, diam. 13.6 mm.; width of umbilicus 2.7 mm.

Genitalia (Pl. XIII, fig. 4).—Penis small and slender, about equal in length to the vagina and of equal calibre throughout. A short, loose sheath envelops its base. The penis-papilla is nearly as long as the penis, very slender, slowly tapering, indistinctly annulate. The slender epiphallus bears the retractor muscle and terminates in a very minute flagellum. Female organs as usual. Jaw (fig. 6) has five or six strong, unequal ribs, or in one specimen four unequal weaker ribs. It is quite variable.

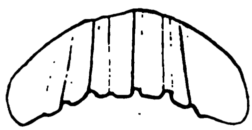


Fig. 6.—Jaw of *Sonorella papagorum*.

The shells show but little variation, excepting size.

Alt. 13.8, diam. 23.5 mm.; aperture 12 x 13.3 mm.
" 12, " 20.5 " " 10 x 11.7 "

Black Mountain, near the mission of San Xavier del Bac, in the Papago Indian Reservation, Pima Co., about 9 miles south of Tucson. Types No. 112,161, A. N. S. P., collected by Pilsbry and Daniels, October 5, 1910.

This shell is less solid than *S. eremita*, with a narrower umbilicus and far weaker apical sculpture.

Black Mountain is a rather remote and isolated outlier of the Tucson Range, which has here its southeastern terminus. It is a long, straight, level-topped ridge, divided by a deep gap into a longer and a shorter mountain. The slopes are everywhere very steep, covered with black basalt, like Tumamoc Hill at Tucson. Slides of this rock occupy a large part of the slopes. Between the slides, which are, of course, barren of vegetation, there is some desert verdure. Ocotillo, mesquite, cat-claw, palo verde, etc., are typical plants, and giant cacti grow on the south side. No agave or sotol were seen. The Sonorellas are found rather deep in the slides. They probably inhabit the whole northern slope, but we worked only a couple of hours, on the north side of the east end, close under the summit. Some hazard attends the hunt in these slides, which are so steep that the heavy rock starts to move on small provocation. Black Mountain, like the rest of the Tucson Range, is very dry. It stands on a plain much lower than the Mineral Hill group and higher than Tucson. The station where *Sonorella* was collected we would roughly estimate as 3,200 or 3,300 feet above the sea.

Sonorella eremita n. sp. Pl. VIII, figs. 7 to 7*e*.

The shell is globose-depressed, umbilicate (the width of umbilicus contained about 6½ times in the diameter of shell), more solid than other species of the same region, glossy, pinkish buff, fading to nearly white around the umbilicus, and having a chestnut-brown shoulder band, without noticeable light borders. The embryonic shell, of about 1⅓ whorls, has strongly developed sculpture of the *hachitana* type. The initial half-whorl has some radial ripples or wrinkles; then there appears a series of long, protractive threads on the outer two-thirds, meeting shorter forwardly ascending threads on the

The top of the head is gray, integument elsewhere cream-tinted. The median area of the sole is whitish, twice as wide as either side area, the latter flesh-tinted.

The genitalia (Pl. XIII, figs. 2, 10).--Penis very small and slender, having a very short, weak basal sheath of a few loose fibres. The papilla is coarsely annulated, very slender and long. The penis-retractor muscle is inserted on the epiphallus, which is extremely slender, not so wide as the vas deferens, but enlarged a trifle where it joins the latter. There is no flagellum. Female organs as usual.

Jaw having four or five unequal ribs, sometimes rather weak (Pl. XIII, figs. 6, 6*a*).

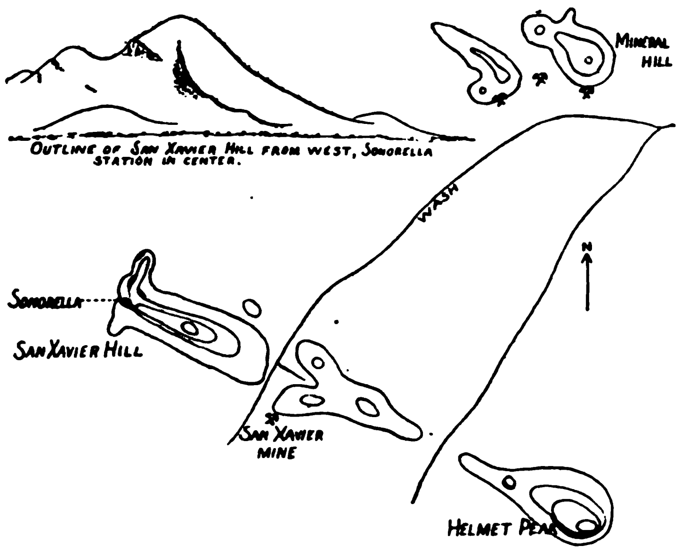


Fig. 7.—Plan of the Mineral Hills, scale 2 inches to a mile, with sketch of the type locality of *Sonorella eremita*.

In the genitalia, as well as the shell, this species resembles *S. papagorum*, but it differs by having a smaller penis and by the very slender epiphallus, which is actually smaller than the vas deferens in several specimens dissected. In *S. tumamocensis* the penis is very much longer. The shell is smaller than *S. papagorum*, with *far more strongly developed apical sculpture* than in any other species of this district. It is also more solid, and, having an aspect of its own, is not likely to be confused with any other *Sonorella* known to us.

The size is quite variable:

Alt. 12.7, diam. 21.3 mm.; whorls $4\frac{1}{2}$.
" 9.9, " 17 "
" 9, " 16 " " $4\frac{1}{3}$.

There was a scalariform specimen among the bones. It measures 13.3 mm. high, 16.6 wide. The normal height for a shell of this diameter should be about 9.5 mm.

The Mineral Hill group, Twin Buttes and Tinaja Hills are much degraded outliers of the Sierrita Mountains. Only the Mineral Hill group has been worked for land snails, though all doubtless have Sonorellas—and very little else.

The Mineral Hills are about 20 miles west of south from Tucson and about 7 miles north of the Sierritas.[8] They stand at the summit of a long slope, rising about 1,000 feet in ten miles from San Xavier del Bac, on a mesa of perhaps 3,600 feet elevation. The xerophytic vegetation extends over the hills, mesquite, cat-claw, palo verde, ocotillo and sotol being the more conspicuous plants, to which may be added tree cacti on southern slopes, and on the mesa many opuntias, cylindropuntias and a few barrel cacti and yuccas. The absence of *Agave* is peculiar. These hills are a favorite resort of rattlesnakes. I got also a coral snake. No mollusks whatever were found on Mineral Hill or Helmet Peak. San Xavier Hill is composed of white subcarboniferous limestone, like the hills southeastward, except at the western end, which is whitish quartz, with a spur to the north of coarse pinkish-gray granite. There is a depression in this end of the hill, between short, low cliffs of white quartz. The cliff towards the south has partly fallen in a tumble of huge blocks with some smaller stone between them. This talus is perhaps

Sonorella sitiens n. sp. Pl. VIII, figs. 5 to 5c.

The shell is depressed, umbilicate (the width of umbilicus contained nine to ten times in the diameter of the shell), rather thin, cinnamon colored (varying in tone), paler around the umbilicus, encircled by a chestnut-brown band at the shoulder, bordered with a white band above and below. Surface somewhat glossy. The initial fourth of a whorl is smooth; the rest of the embryonic shell has very fine, anastomosing and interrupted radial wrinkles, and on some specimens there are the faintest traces of spiral threads. The neanic and last whorls are marked with delicate growth lines. Spire low; whorls 4½, convex, the last slowly descending in front. Aperture oblique, rounded oval. Peristome thin, the upper margin hardly expanded, outer and basal margin, a little expanding.

Alt. 11, diam. 20 mm.; aperture, alt. 10, diam. 12 mm.

The back, top and sides of head are slate colored, the tail and a wide band above the foot edges whitish.

Genitalia (Pl. XIII, fig. 3).—The penis is swollen distally, becoming narrow in its basal half, which is enveloped in a muscular sheath, the outer edge of which is attached to the end of the epiphallus. The *penis-papilla is extremely short* and wide, cylindric, with a few annular corrugations and a shortly conic end. The epiphallus is slender, swollen at its distal end, without trace of a flagellum. The lower part of the vagina is very stout. Other organs as usual.

Jaw (Pl. XIII, fig. 7) has 8 strong, narrow ribs.

Northwestern end of Las Gijas above Las Gijas Mine, Pima Co., Arizona. Types No. 112,158, A. N. S. P., taken by Ferriss and Pilsbry, September 27, 1910.

The shell is less solid than *S. eremita*, the aperture decidedly larger, the umbilicus smaller. The color also is darker. It differs from *eremita* conspicuously in the genitalia, the penis of *S. sitiens* being provided with a sheath of half its length, and the papilla being extremely short and stout, while in *S. eremita* the sheath is represented only by a few loose muscular fibres at the base, and the papilla is very slender and comparatively long. No other *Sonorella* known has a penis-papilla like that of *S. sitiens*. Several specimens dissected are entirely similar in genitalia.

The spire is very low in most of the specimens, but in one (Pl. VIII, fig. 5c) it is more conic. In this shell the white borders of the shoulder band are very narrow. It measures, alt. 12, diam. 18.5 mm., aperture 9.5 mm. high, 10.8 wide.

Five other adult shells measure:

Alt. 11,	diam. 19	mm.;	aperture	9.9 x 11.25	mm.
" 11.3,	" 19	"	"	9.9 x 11	"
" 10.8,	" 18.8	"	"	9.9 x 11	"
" 10.3,	" 18	"	"	9.2 x 10.5	"
" 10,	" 17.8	"	"	9 x 10.3	"

The most closely related species seems to be *S. rowelli*. This, however, has a larger penis-papilla and a slightly wider umbilicus.

The low and inconspicuous range Las Gijas (the Quartz Hills) lies south of the well-known landmark Cerro Colorado, and west of the northern end of the Tumacacori Range. At the northwest end there is a mine, and a ranch building stands on the bank of a small stream, the Gija Wash. The hill above the mine is strewn with rounded boulders of coarse-grained granite, weathering to angular gravel. Most of the loose rock is too massive to move, so that suitable situations for snails are scarce. We found the first Sonorellas on the slope above the mine. Working up over the rounded top of the hill and along the ridge a half mile south we crossed a low rock dyke, where a few more shells and a large colubrine snake were taken. None were found among the rocks at the head of the canyon east of this ridge. The other hills at this end of the range are rounded, grassy, with little rock. On top there is much sotol, ocotillo, a few cacti, etc. We found the pygmy *Agave parviflora* here. It was not seen elsewhere.

In the débris of the Gija Wash we found *Thysanophora hornii* (Gabb), *Zonitoides minuscula* (Binn.) and *Bifidaria pelleucida hordeacella* (Pils.).

Measurements of the genitalia of the preceding species are here given together. The species identified as *S. rowelli* (Nc.) in these

Sonorella sitiens arida n. subsp. Pl. VIII, figs. 6, 6a, 6b.

The shell resembles *S. sitiens*, but differs in these features: the umbilicus is decidedly wider, its diameter contained 6 to nearly 7 times in that of the shell; the color is paler; the aperture is noticeably smaller. The embryonic 1½ whorls show distinct spirally protractive threads in young individuals.

Alt. 10.8, diam. 19 mm.; aperture, alt. 9, diam. 10.2 mm.; umbilicus 3 mm.

Alt. 10, diam. 18.5 mm.; aperture, alt. 9, diam. 10 mm.; umbilicus 3 mm.

Alt. 10.25, diam. 19.9 mm.; aperture, alt. 9.9, diam. 11 mm.; umbilicus 2.9 mm.

Cerro Colorado, around the base of a conspicuous crag at the southeastern end of the range. Types No. 112,160, A. N. S. P., collected by Pilsbry and Ferriss, September 28, 1910.

The first two measurements are of cotypes from the south side of the crag. The third specimen measured is the only adult shell taken on the north side of the crag, perhaps a hundred feet higher.

This form stands very close to *S. sitiens*, yet the difference in the size of umbilicus is constant in the small series examined; no communication between the colonies of Cerro Colorado and Las Gijas can have taken place for a very long period, so that in the present state of our knowledge it seems proper to keep the forms of the two hill-groups subspecifically separate.

Unfortunately, no living examples were found, so that the anatomical characterization of the subspecies remains to be worked out.

The Cerro Colorado ("Red Hill") lies a few hours' travel north of Las Gijas. The northern slopes are grassy and rounded, but west and south it is carved into bold, fantastic crags and pinnacles of dull red rhyolite—a landmark which catches the eye for a long distance.

Our work here was brief. Scarcely an hour was spent around a crag which stands at the southeastern extremity, about two miles from the Cerro Colorado Mine on the Aravaca Road. Here the *Sonorella* described above was taken, only a few dead specimens. No doubt, the cliffs westward, higher up, would yield better results, though little can be expected in such a dry situation. Neighboring low crags of milk-white quartz, at a lower level southward, were found barren.

Sonorella sitiens comobabiensis n. subsp.

The shell is similar to *S. sitiens* in general shape, its width contained about 9 times in the greatest diameter of the shell. It is smaller within, and enlarges more in the last whorl than that of *S. tuma-*

mocensis, but the enlargement is largely concealed by the overhanging and dilated columellar lip. It is light pinkish cinnamon, fading to white around the umbilicus, usually with a white streak on the last whorl, left by a former resting stage, and with white bands above and below the rather wide chestnut-brown shoulder band. The apical sculpture is of the *sitiens* type, but some interrupted, descending spiral threads are visible on the best examples; subsequent whorls are lightly marked with growth lines. The aperture is larger than in *S. tumamocensis*, but less ample than that of *S. vesperus*. The peristome expands distinctly, though narrowly.

Alt. 10.1,	diam. 18,	longest axis of aperture	10.1 mm.;	$4\frac{3}{4}$ whorls.
" 10.8,	" 19,	" " "	11.5 "	$4\frac{3}{4}$ "
" 9.7,	" 17.4,	" " "	10.3 "	$4\frac{1}{2}$ "

Comobabi Mountains, at the base of a cliff on the north side of the highest part of the range, elevation about 4,000 feet. Type and paratypes No. 112,252, A. N. S. P., other paratypes in Ferriss collection. Also taken in the Cababi Hills, about 10 miles westward, in a slide of volcanic rock on the north side of the highest peak, about 3,000 feet elevation. All were collected by Mr. J. C. Blumer, of Tucson, in the course of botanical exploration.

About 120 specimens were collected, some of them showing the surface and color unimpaired, though all were dead shells. We are therefore unable to give any information on the soft parts. The shell is very much like *S. sitiens* of Las Gijas, further south, and east of the Baboquivari Range; but on account of the wide separation of the localities, it is likely to be subspecifically or even specifically distinct.

The Comobabi Mountains form a short range, about 75 miles

oblong, contained between seven and eight times in the diameter of the shell. Avellaneous in color, paler around the umbilicus and slightly so on both sides of the chestnut-brown shoulder band. Surface glossy, lightly striate, the embryonic shell of 1¾ whorls with *S. hachitana* sculpture.

Whorls 5, slowly widening, the last whorl very broad and capacious, rather strongly descending to the aperture. The aperture is very large, oblique, the peristome well expanded except near the upper termination; margins converging, joined by a thin callus.

Alt. 15.7, diam. 28.4 mm.; umbilicus 3.7 mm.; aperture 16.4 mm. wide, 13.7 high.

Cababi Mountains (about 75 miles west of Tucson), collected by Frank Cole, March, 1915. Type No. 112,253, A. N. S. P., cotypes in Ferriss collection.

This is one of the largest species, very much resembling *S. ashmuni* Bartsch, from Richinbar, Yavapai Co., which has a slightly smaller aperture. As the localities are several hundred miles apart and separated by the depression of the Gila River, they will probably turn out to be distinct when the genitalia of both are examined; but as no differences which could reasonably be called specific appear in a close comparison of the types, we rank the southern form as a subspecies.

The nine specimens collected measure 28.4, 27.9, 27.8, 25.5, 24.8, 24.6, 24.5, 24, 23.9 mm. diameter, being therefore variable in size.

Sonorella ashmuni ambigua n. subsp. Pl. X, figs. 6, 6a, 6b.

The shell is smaller than *S. a. capax* (diameter 20.9 to 23.4 mm.) with the last whorl widening somewhat less, the aperture more rounded.

Alt. 13.5, diam. 22.5 mm.; umbilicus 3 mm.; aperture 12.2 mm. wide, 11 high. Whorls 4½.

Cababi Mountains; No. 112,254 sent with the preceding, but whether collected in the same place is not known. They were taken in March, 1914, by Mr. Frank Cole, Mr. Ferriss' guide in 1913.

Thirty-two specimens measure as follows in diameter: 20.9, 21 (2), 21.1, 21.3 (2), 21.4 (2), 21.5, 21.6 (2), 21.7 (2), 21.8, 22 (5), 22.2 (2), 22.3, 22.4, 22.5 (3), 22.6, 22.7, 23, 23.2, 23.3, 23.4.

We are in some doubt about the status of this form, but it is readily separable from *S. a. capax* in the series seen. The genitalia when examined will no doubt clear up the uncertainty.

VI. The Baboquivari Mountains.

We had not intended at first to visit the Baboquivaris. From our camp, above 7,000 feet in the Santa Ritas, the long ridge, sixty miles distant, bounded the western horizon. We could see the wonderful obelisk of Baboquivari Peak catch the morning sun while the great valley between slept in dusk. At evening it stood silhouetted, velvet black, between the purple valley and flaming sky. To visit this range, beyond which there is no water, became an obsession, and finally we made the two-day journey by wagon, camping midway on Sopori Creek, where there was a little stagnant water for the horses.

The Baboquivari Range is a single, long, north and south ridge with numerous short lateral spurs. Its chief landmark, Baboquivari Peak, is a huge obelisk of dull red rhyolite, standing on the main axis of the range, flat topped, its sides practically vertical. The foothills and lower slopes of the range have many barrel cacti, opuntias, agaves, very few giant cacti. The lower courses of the canyons are green with mesquite and cat-claw. The higher mountains are grassy and lack large cacti; only a flat *Mamillaria* and the little rainbow cactus were noticed. There is some scattering oak, size of a peach tree, on western and northern slopes, and very few stunted pinyons around the high crags. The herbaceous plants are chiefly the same as in the Santa Ritas. Sycamore Canyon has a richer sylva—buttonwood, walnut, hackberry, a fine dark-leaved species of oak, etc. There is water in Oro Fino and Sycamore Canyons, and we found some also near the head of Thomas Canyon, about half a mile below the peak. Near the mouth of Sycamore there was in 1910 a foresters' house (which we occupied), a corral

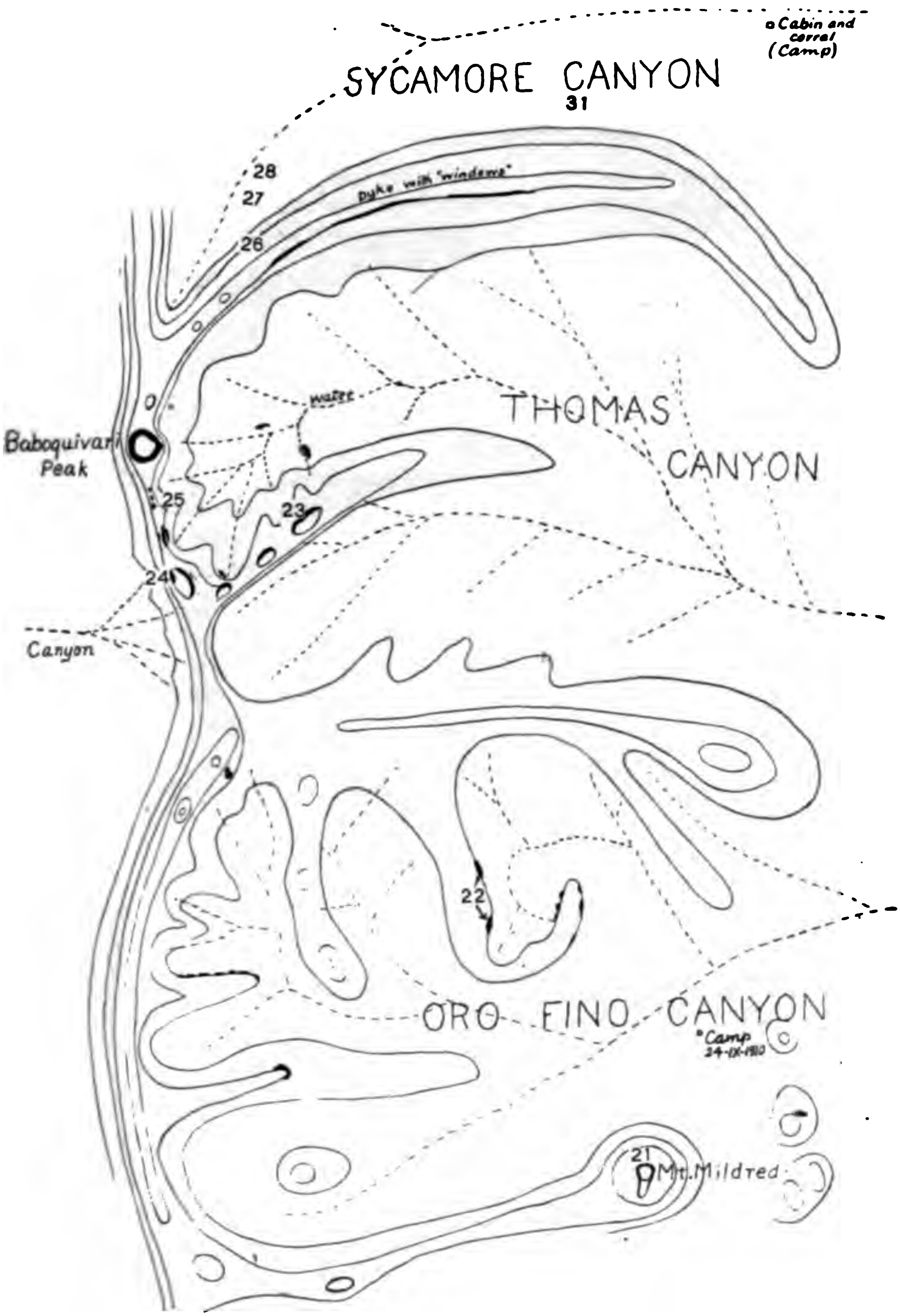


Fig. 8.—Map of a section of the Baboquivari Range, to show type localities and other collecting stations.

Station 22. Low crags in the northern part of Oro Fino Canyon.

Station 23. Crags on the southern rim of the northern branch of Thomas Canyon.

Station 24. West side of the main ridge near summit, south of Baboquivari Peak. *Vitrea indentata umbilicata* and *Sonorella vespertina*.

Station 25. East side of ridge, about half a mile from the peak.

Station 26. Near the southwestern head of Sycamore Canyon, between one and two hundred yards below the summit of the Thomas-Sycamore ridge, in a rock "slide."

Station 27. About 1,000 feet below Station 26, near the bottom of the canyon.

Station 28. Not far below Station 27.

Station 29. Bed of upper Sycamore Canyon, about a mile above the foresters' cabin, and not far above the dam.

Station 30. Creek in Sycamore Canyon (a small *Physa*, not determined with certainty, was the only fresh-water shell found at this station).

Station 31. Sycamore Canyon, about 3 miles up its bed, and ¾ mile up a southwestern branch ravine. *Succinea avara* Say and *Sonorella baboquivariensis* only.

Sonorella vespertina n. sp. Pl. X, figs. 5, 5*a*, 5*b*.

The shell is umbilicate (width of umbilicus contained 9 or 10 times in diameter of the shell); cinnamon, fading to whitish around the umbilicus, and with white bands above and below the chestnut-brown shoulder band. Surface glossy, the initial half-whorl having some radial wrinkles, the rest of the embryonic shell without any distinct sculpture, though there is some extremely indistinct radial roughness, stronger near the suture. In fresh young shells of 2½ whorls the surface of the last embryonic and first neanic whorls is densely set with very short hairs, extending also over the base.

and weakly annular. The vagina is slender and long. Free vas deferens very long. The organs of two individuals measure:

Penis.	Papilla.	Epiphallus.	Vagina.
3.2	2.5	5.5	5.5 mm.
3	2.5	7	5.5 mm.

Baboquivari Mountains, at Station 24, on the west side of the ridge, close to the summit, a half-mile south of Baboquivari Peak. Type No. 111,554, A. N. S. P., topotypes in collections of Ferriss and Daniels. Also on the north side of the highest peak of the Qui-i-tomoc Hills, J. C. Blumer.

This species is readily distinguished from *S. baboquivariensis* by the wider umbilicus, smaller aperture, the shorter, steeper descent of the last whorl to the aperture, and the absence of distinct sculpture on the embryonic whorl; also by the very different genitalia.

By the small penis and slender, tapering penis-papilla, *S. vespertina* is closely related to *S. tumamocensis* and *S. eremita*. In shell characters it comes very close to *S. sitiens*, which differs by the form of its penis-papilla.

S. vespertina was found at our only collecting station west of the summit of the range, but it occurred there in considerable abundance. Over 100 living individuals and numerous "bones" were taken by two of us in about three-quarters of an hour, in the course of our tramp from camp in Oro Fino Canyon to the peak and down to camp in Sycamore Canyon.

The specimens taken in the Qui-i-tomoc Hills have not been dissected, but we cannot distinguish the shells from the Baboquivari *vespertina*.

Sonorella baboquivariensis n. sp. Pl. X. figs. 1 to 2b.

The shell is very narrowly umbilicate, globose-depressed, thin, glossy, cinnamon or sayal brown, fading or whitish around the umbilicus and on both sides of the broad chestnut-brown shoulder band. First third of a whorl smooth, the following whorl with sculpture of irregular radial wrinkles, over which run spiral, slowly descending, irregular threads; later whorls marked with fine growth lines as usual. Whorls 4½, the last very wide, its last fourth slowly and rather deeply descending. *The aperture is very large*, strongly oblique. Peristome narrowly expanding throughout, the columellar margin brown-edged, broadly dilated and reflexed half over the umbilicus. The parietal callus has an opaque, pale brown edge.

Height 13.2, diam. 21 mm.

Genitalia (Pl. XIII, fig. 1).—The penis is long, the distal fourth

enlarged, the rest slender. The basal third or less is sheathed, the sheath composed of firm, circular muscles. The papilla (fig. 1, *pp.*) is cylindric, with a conic, glandiform end. The retractor muscle is inserted on the epiphallus, which is nearly as long as the penis, and bears a short flagellum. The vagina is about three-fourths as long as the penis. In two individuals the organs measure, in mm.:

Station.	Penis.	Papilla.	Epiphallus.	Flagellum.	Vagina.	Diam. shell.
25	12	3	11	0.75	9	21
22	10	2.7	8.5	0.75	8.2	19

Baboquivari Mountains, the types No. 111,549, A. N. S. P., from Station 25, in the head of Thomas Canyon about half a mile from Baboquivari Peak. Also at Station 23, at the northern bases of crags at summit of the spur which divides Thomas Canyon. In Sycamore Canyon, at Station 26, in a slide on the ridge of the head branch, about 300 feet or more below the summit; Station 27, about 1,000 feet lower, near bed of canyon; Station 28, still lower, and Station 31, further down the canyon, low on the south side.

In Oro Fino Canyon it was taken at Station 21, at the foot of the cliffs on north side of Mount Mildred, a conspicuous butte at the southern side of the mouth of the canyon; also Station 22, among low crags near the north side of the canyon.

This is the common species of the Baboquivaris throughout the short section of the range which we explored. It is distinguished by having a larger aperture than any other *Sonorella* known. The

[redacted]

21 mm. At Station 28, still lower, the range in diameter is from 17 to 20 mm. At Station 31, much nearer the mouth of the canyon, the shells are about typical.

Sonorella baboquivariensis depressa n. subsp. Pl. X, figs. 3, 3*a*, 3*b*.

The shell is more depressed than typical *baboquivariensis* with the umbilicus decidedly more widely open; aperture smaller. Alt. 9.8, diam. 17.7 mm.

Baboquivari Mountains, low in upper Sycamore Canyon, Station 29. Type No. 111,559, A. N. S. P.

Explanation of Plates VIII to XV.

Plate VIII.—Figs. 1–1*b*.—*Sonorella dragoonensis*. Type. Station 28, Dragoon Mountains. No. 103,094.
Figs. 2–2*b*.—*Sonorella apache*. Type. Station 9. No. 111,529.
Figs. 3–3*b*.—*Sonorella ferrissi*. Type. Station 38. No. 103,097.
Figs. 4–4*b*.—*Sonorella bartschi*. Type. Station 1, Mule Mountains. No. 103,095.
Figs. 5–5*c*.—*Sonorella sitiens*. Type. Las Gijas. No. 112,158.
Figs. 6–6*b*. *Sonorella sitiens arida*. Type. Cerro Colorado. No. 112,160.
Figs. 7–7*e*.—*Sonorella eremita*. Type. Mineral Hills. No. 112,159.
Figs. 8–8*b*.—*Sonorella papagorum*. Type. Black Mountain. No. 112,161.

Plate IX.—Figs. 1–1*b*.—*Sonorella santaritana*. Type. Station 5. Santa Rita Mountains. No. 112,105.
Figs. 2–2*b*.—*Sonorella santaritana*. Station 5. No. 112,107.
Fig. 3.—*Sonorella santaritana*. Albino. Station 5. No. 112,106.
Figs. 4–4*b*.—*Sonorella walkeri*. Type. Station 5. No. 112,164.
Figs. 5–5*b*.—*Sonorella walkeri aguacalientensis*. Type. Station 2. No. 112,162.
Figs. 6–6*b*.—*Sonorella walkeri aguacalientensis*. Station 1. No. 112,166.
Figs. 7–7*b*.—*Sonorella granulatissima occidentalis*. Type. Station 17. No. 112,165.
Figs. 8–8*b*.—*Sonorella clappi*. Type. Station 8. No. 112,163.

Plate X.—Figs. 1–1*e*.—*Sonorella baboquivariensis*. Types. Station 25, Baboquivari Mountains. No. 111,549.
Figs. 2–2*b*.—*Sonorella baboquivariensis*. Station 22. No. 111,560.
Figs. 3–3*b*.—*Sonorella baboquivariensis depressa*. Types. Station 29. No. 111,559.
Figs. 4–4*b*.—*Sonorella tumamocensis*. Type. No. 112,245.
Figs. 5–5*b*.—*Sonorella vespertina*. Type. Station 24. No. 111,554.
Figs. 6–6*b*.—*Sonorella ashmuni ambigua*. Type. No. 112,254.
Figs. 7–7*b*.—*Sonorella ashmuni capax*. Type. No. 112,253.

Plate XI.—Fig. 1.—*Sonorella bartschi* n. sp. Genitalia. No. 103,095, A. N. S. P.
Fig. 1*a*.—Penis-papilla of same.
Figs. 1*b*, 1*c*.—Jaws of two topotypes. No. 103,095.
Fig. 2.—*Sonorella bartschi*, variety. Genitalia. Near Warren, Arizona.
Fig. 2*a*.—Penis-papilla of same.
Fig. 2*b*.—Jaw of same.
Fig. 3.—*Sonorella ferrissi* n. sp. Genitalia.
Fig. 3*a*.—Penis-papilla of the same.
Fig. 4.—*Sonorella dragoonensis*, n. sp. Genitalia. No. 103,093.
Fig. 4*a*.—Penis slit open showing the penis-papilla of same.
Fig. 5.—*Sonorella apache* n. sp. Genitalia.

Fig. 5*a*.—Penis-papilla of the same.
Fig. 5*b*.—Median transverse section of the penis-papilla.
Fig. 5*c*.—Upper end of the penis-papilla opened to show the conic nipple in the apex of the cavity.

PLATE XII.—Figs. 1, 1*a*.—*Sonorella walkeri*. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 8, Santa Rita Mountains.
Fig. 2.—*Sonorella walkeri*. Genitalia. Station 5, Walnut Canyon, Santa Rita Mountains.
Fig. 3.—*Sonorella walkeri*. Genitalia. Station 5.
Figs. 4, 4*a*.—*Sonorella clappi* var. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 17, Santa Rita Mountains.
Figs. 5, 5*a*.—*Sonorella walkeri*. Genitalia and detail of penis-papilla, epiphallus and flagellum. Station 15.
Fig. 6.—*Sonorella clappi*. Genitalia. Station 8.
Fig. 7.—*Sonorella clappi*. Genitalia. Station 12.

PLATE XIII.—Fig. 1.—*Sonorella baboquivariensis*. Genitalia and detail of penis-papilla. Station 25, Baboquivari Mountains.
Figs. 2, 10.—*Sonorella eremita*. Genitalia of two individuals of the type lot, No. 103,100.
Fig. 3.—*Sonorella sitiens*. Genitalia and detail of penis-papilla, and epiphallus of a topotype. No. 103,102.
Fig. 4.—*Soronella papagorum*. Genitalia and detail of penis-papilla. No. 103,099.
Fig. 5.—*Sonorella tumamocensis*. Genitalia and detail of penis-papilla.
Figs. 6, 6*a*.—*Sonorella eremita*. Jaws of two individuals.
Fig. 7.—*Sonorella sitiens*. Jaw of type. No. 103,102.
Fig. 8.—*Sonorella tumamocensis*. Jaw of types. No. 103,101.
Fig. 9.—*Sonorella vespertina*. Terminal ducts of genitalia with detail of end of the penis-papilla. Cotype.
Fig. 10.—*Sonorella eremita*. Terminal ducts of genitalia. No. 103,100.

PLATE XIV.—Figs. 1–1*b*.—*Holospira danielsi*. Type and paratypes. Tweed Canyon, Station 2. No. 112,199.
Figs. 2–2*c*.—*H. danielsi*. Station 39. No. 112,198.
Figs. 3, 3*a*.—*H. danielsi*. Station 18. No. 112,195.
Figs. 4–4*b*.—*H. danielsi*, variety. Station 12. No. 112,196.
Figs. 5, 5*a*.—*H. danielsi*, variety (?) Station 40. No. 103,092.
Fig. 6.—*Holospira campestris cochisei*. Station 21. No. 112,218.
Figs. 7–7*f*.—*Holospira campestris cochisei*. Cotypes. Station 16. Figs. 7*d*, 7*e* opened to show the internal lamellæ. No. 112,219.

THE DIVERSITY OF ECOLOGIC CONDITIONS AND ITS INFLUENCE ON THE RICHNESS OF FLORAS.

BY JOHN W. HARSHBERGER, PH.D.

The ecologic conditions of vegetation are those which are connected with the influence of the environment on the plants. The factors which influence the growth and the distribution of species may be divided into Climatic, Edaphic, Physiographic, Biotic, and Chronologic (Geologic-Historic). The climatic factors include the influence of temperature, moisture, light and wind. The edaphic factors are connected with the conditions of the soil. The physiographic factors are concerned with the physical structure of the geosphere (land surface) and the hydrosphere (water surface) of our planet. The biotic factors are those in which plants and animals (including man) are influential. The chronologic factors deal with the past geologic and paleontologic conditions of the earth, while the historic data are concerned chiefly with the past distribution of plants and their probable successional history. The diversity of ecologic conditions is the diverse character of the climate, soil, physiography, life and chronology of any region.

The richness of a flora may be considered from a number of different points of view. We may consider it numerically, that is the actual number of species; or we may consider its richness in generic types, in endemic types, in introduced plants, in common plants, in rare plants, in relict species, in biologic forms (such as xerophytes, hydrophytes) and in growth forms (trees, shrubs, lianes) or in the types suggested first by Raunkiaer, namely, the phanerophytes, the chamæphytes, the hemicryptophytes, the helophytes and the geophytes. If we use the system of Raunkiaer and arrange the above types by percentages, then we would have a climatic spectrum which would enable us to make a comparison with the floras of other lands and climes similarly arranged. An attempt will be made to study the diversity of ecologic conditions and its influence on the richness of the floras of a number of different phytogeographic regions of North America. Those regions will be chosen with which the writer is more or less familiar, and regions which have been studied carefully by other botanists and their floras catalogued.

The regions of little physiographic diversity are the following: Point Pelee, Ontario, jutting into Lake Erie, comprises that part of Essex County at the western end of the lake, and in the enumeration of its plants those found on Pelee Island are included. Point Pelee is a triangular piece of land with its acute angle running about 9 miles south into Lake Erie. About nine-tenths of this tract is mostly a very wet marsh between the east and west beaches. Within this marsh limit are several ponds and small lakes, while on the east and west sides are narrow low, sandy beaches, the western one backed by sand dunes. Outside the marsh the land is sandy. No geographic configuration could be much more simple. C. K. Dodge[1] has found 466 genera and 623 species of ferns and seed plants on Point Pelee. The generic coefficient, which is the proportion of genera to species in a flora, is for the Point flora 74.7 per cent.

The pine-barren region of New Jersey is a country of slight relief. The soil is sandy, underlaid by gravel. The streams which flow into the Atlantic Ocean have nowhere a rapid current, and their mouths are influenced by tide water. The hills are low, the steeper ones having gradual slopes. Natural lakes are small and widely scattered. The lower drainage levels are occupied by marshes and swamps. With this simple topography we find a numerically poor flora of 250 genera and 555 species of native plants, so that the generic coefficient is 45 per cent.

Hartsville, South Carolina, the flora of which has been investigated by Coker,[2] is found on the inner drier part of the Atlantic coastal plain. Just north of the town proper is a rapid descent of about 50 feet into the valley of Black Creek. This valley with certain irregularities extends approximately one-half mile and is terminated

Harper[3] finds that there are 404 genera and 797 species of plants, giving, therefore, a generic coefficient of 50 per cent.

Miami Florida, is situated on the oölitic limestone formation of south Florida.[4] The flat, featureless country is relieved by short streams which drain the Everglades (of simple topography) into the Atlantic Ocean. The sea beaches are of silicious sand. Small enumerates 466 genera and 796 species in his *Flora of Miami*, and the calculated generic coefficient is, therefore, 59 per cent.

The Florida Keys[5] are of even simpler configuration than the adjoining mainland. There are no running streams and the limestone soil is singularly porous. Besides, the islands are narrow and their shores are rocky, of calcareous sands, or mud-fringed. The entire number of genera is, according to Small, 346 and the number of species is 533, giving the exceptionally high coefficient of 65 per cent.

Selecting a number of other localities, we find that the vegetation of the upper Susquehanna[6] in New York and Pennsylvania is developed on a soil of glacial origin, in fact the whole region was glaciated. Here there is a relatively rich flora of 462 genera and 1105 species of seed plants and ferns. The generic coefficient of the upper Susquehanna flora, is, therefore, 41.8 per cent.

Lancaster County, Pennsylvania, is in a region of rich, agricultural development, which has been dependent on the limestone soils, suitable to the tobacco plant, which thrives upon such soils without depleting seriously the natural mineral fertilizers. The county is in the rolling Piedmont district where the hills are rounded, the streams quiet and the topography comparatively simple and unmountainous with broad, fertile valleys between the ranges of hills. The Susquehanna River runs along the western boundary for about forty miles and for over one-half of this distance it passes through a canyon with steep sides and a southern exposure where plants of a more southern distribution are at home. Sphagnum swamps among the hills have a more northern flora. Shale and sandstones border the northern part of the county, and south of the middle belt of limestone, schistic rocks occur with some outcrops of serpentine.

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[3] Harper, Roland M.: *Ann. N. Y. Acad. Sci.*, 17 : 323.

[4] Harshberger, John W.: The Vegetation of South Florida south of 27° 30′ North, exclusive of the Florida Keys, *Transactions Wagner Free Institute of Science of Philadelphia*, VII, Part 3, October, 1914, p. 183.

[5] Small, John K.: Flora of Miami, 1913; Flora of the Florida Keys, 1913.

[6] Clute, Willard N.: The Flora of the Upper Susquehanna and its Tributaries, 1898.

Small[7] enumerates 617 genera and 1464 species of Lancaster County plants, so that we have a generic coefficient of 42.1 per cent.

As a general rule, the smaller the area of land, the more simple and uniform the configuration of that country. There are of course exceptions to this fact. Fortunately, we have two floras from which we can draw conclusions. Daniels[8] has studied the flora of Columbia, Missouri, and vicinity and Mackenzie[9] has enumerated the plants of Jackson County, the same State. Columbia is in the tension belt between forest and prairie. The prairie vegetation is that of Illinois and Iowa; the forest vegetation is that of the Ozark Plateau of Missouri and northern Arkansas. The bottoms of the Missouri River bring hither the alluvial flora and in the ponds and marshes occurs the hydrophytic flora of the eastern United States. Jackson County is bounded on the north by the Missouri River. There are river sand bars, high and rocky bluffs, and an uneven country threaded by small rivers. Prairie country lies between the streams. Barrens are found where the limestone rocks are covered by a thin soil, with a bog region found along the Missouri bluffs west of Sibley. Daniels lists 435 genera and 1058 species of plants about Columbia. The generic coefficient is 41.1 per cent. Mackenzie enumerates 500 genera and 1141 species in the flora of Jackson County with a calculated generic coefficient of 43.8 per cent.

The Pacific coast flora also illustrates the same principle first enunciated by Jaccard,[10] that the generic coefficient is inversely proportional to the diversity of the ecologic conditions. Hall[11] has written one of the best local floras extant. The Yosemite National Park presents a great variety of conditions, but as compared with the central Rocky Mountain region or the entire Sierra Nevada

plants in Hall's *Yosemite Flora*, we get, omitting the grasses, sedges, rushes and varietal forms, a total of 741 species and 311 genera with a generic coefficient of 41.9 per cent. If the omissions are supplied, Hall estimates that there would be not less than 1200 species in the park area of 1124 square miles.

The selection of regions of greater physiographic diversity, than those which we have discussed, brings out some interesting facts. It shows that our study is a comparative one, as we have contrasted areas such as Point Pelee and the Florida Keys with regions of somewhat greater diversity, such as Jackson County, Missouri and the Yosemite National Park, California. A greater contrast is seen when we compare the Yosemite region of considerable diversification of topography with regions of even greater natural environmental conditions.

The flora of the State of Connecticut,[12] which has a great variety of soils, slope exposures, river systems and tidal estuaries, includes 621 genera and 1942 species, so that the generic coefficient is 31.9 per cent. As a close approximation to this coefficient yielded by a flora at about the same latitude and not far removed geographically, we have the flora of the vicinity of New York. In his monograph, Taylor[13] lists 830 genera and 2651 species of plants. The physiography of the New York region includes salt marshes, estuaries, sea beaches, large river systems, mountains, as the Catskills and the Poconos, sandy country, as the pine-barrens of New Jersey, and morainic deposits in Long Island and elsewhere. Hence we find the percentage 31.3 per cent. to be an expression of that diversity.

The flora of a great state like Pennsylvania,[14] with all kinds of soils, river systems, lakes, bogs, mountain systems and plateaus, might be expected to give a low generic coefficient, and we find on counting that there are 680 genera and 2275 species of ferns and seed plants, so that the coefficient is 29.8 per cent.

Consulting the *Flora of Tennessee*, by Gattinger, published in 1901, we find that for that state, with a high and ancient system of mountains in its eastern end, that there are 755 genera and 2218 species of plants, a considerable number less than in Pennsylvania, and that the generic coefficient of the Tennessee flora is 34 per cent.

The plant life of Alabama[15] as concerns the pteridophytes and

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[12] Committee Conn. Bot. Soc. Catalogue of the Flowering Plants and Ferns of Connecticut, 1910.
[13] Taylor, Norman: Flora of the Vicinity of New York, 1915.
[14] Small, John K.: Flora of Pennsylvania, by Thomas C. Porter, 1903.
[15] Mohr, Charles: Plant Life of Alabama, 1901.

spermaphytes, in a region of great physiographic diversity comprises 822 genera and 2502 species, yielding a generic coefficient of 32.8 per cent.

However, if we use Coulter and Nelson's *New Manual of Botany of the Central Rocky Mountains* (1909), we find that 23.7 per cent. is the generic coefficient for that region where the diversity of land configuration is great and where the ecologic conditions present striking differences. There are listed in this manual 649 genera and 2733 species.

The differences presented by the generic coefficients of different countries is illustrated by reference to the *Flora of the State of Washington*, by Charles V. Piper (1906), and by an enumeration of the genera and species given in Jepson's *Flora of Western Middle California* (1901). The first work gives 614 genera and 2279 species, as the richness of the Washington flora, while Jepson's book includes 421 genera and 1449 species. The generic coefficient for the flora of Washington was determined to be 26.9 per cent. and for that of western middle California 29 per cent.

In such regions as the Appalachian Mountains, which represent an ancient upheaval, and are covered with a deciduous forest, which has occupied the region since the Miocene, the chronologic factor must be considered as one of the factors influencing the numerical richness of the flora. This fact is also illustrated in California, where the diversity of the coast flora in endemic types, as contrasted with that of the Sierra Nevada Mountains, is linked intimately with the past geologic history of the country. Although possessing many species in common, the flora of the coast ranges of California is decidedly different from that of the Sierra Nevada. Jepson regards

comparative figures. Small includes in his *Flora of the Southeastern United States* (1913), 6364 species and 1494 genera, giving a generic coefficient of 23 per cent. The total number of genera and species in Gray's *Manual*[16] is 821 genera and 3413 species, or 24 per cent., for the British flora 734 genera and 2964 species, or 24 per cent., and for Switzerland 659 genera and 2453 species, or 27 per cent.

If we place in sequence the numbers which we have given above, it becomes evident that we can arrange our regions so that we discover that no two places are alike with respect to the diversity of the physiographic conditions.

Region.	Species.	Genera.	Generic Coefficient.
Point Pelee, Ontario	623	466	74.7 per cent
Florida Keys	533	346	65 "
Miami, Florida	796	466	59 "
Hartsville, South Carolina	628	344	54.6 "
Altamaha Grit Region, Georgia	797	404	50 "
Pine Barrens, New Jersey	555	250	45 "
Jackson County, Missouri	1141	500	43.8 "
Lancaster County, Pennsylvania	1464	617	42.1 "
Yosemite National Park (incomplete)	741	311	41.9 "
Upper Susquehanna	1105	462	41.8 "
Columbia, Missouri	1058	435	41.1 "
Tennessee	628	344	34 "
Alabama	2502	822	32.8 "
Connecticut	1942	621	31.9 "
New York and vicinity	2038	830	31.3 "
Pennsylvania	2275	680	29.8 "
Switzerland	2453	659	27 "
State of Washington	2219	614	26.9 "
Colorado	2912	702	24.1 "
Northeastern United States	3413	821	24 "
Great Britain (Druce)	2964	734	24 "
Central Rocky Mountains	2733	649	23.7 "
Southeastern United States	6364	1494	23 "

The figures of this table are a partial confirmation of Jaccard's law of plant distribution, applied for the first time to a statistic study of the American flora. It seems, therefore, "that the generic coefficient is inversely proportional to the diversity of ecologic conditions." Such regions as the central, northeastern and southeastern United States, central Rocky Mountains, Great Britain, and Switzerland have ecologic conditions of the greatest diversity, and hence low generic coefficients, while the Pelee region, the Miami region and that of the Florida Keys with fairly uniform physiography have relatively high generic coefficients.

[16] Robinson, B. L., and Fernald, M. L.: A Handbook of the Flowering Plants and Ferns of the Central and Northeastern United States and Adjacent Canada, 1908.

4. Fumerolic deposits
   (No chemical or historical subdivision practicable)

II. Sedimentary Phenomena

1. Sediments
   A. Siliceous (including argillaceous)
   B. Calcareous (including magnesian)
   C. Ferruginous (including manganiferous and zinciferous)
   D. Saline
   E. Phosphatic
   F. Carbonaceous
   Each of the above divisions is subdivided as follows:
      a. Primary
      b. Metamorphosed
      c. Weathered

The Classification Applied to Minerals

I. 1. A. Silicic Igneous Rocks

a. Primary

Silicon oxides:	quartz, tridymite
Feldspars; orthoclases:	orthoclase, anorthoclase, microcline
plagioclases:	albite, oligoclase
Metasilicates; pyroxenes:	augite; spodumene; rhodonite
amphiboles:	hornblende
miscellaneous:	iolite
Orthosilicates: garnets:	almandite, andradite

Oxides; double; rare-earth-:	ilmenite, pseudobrookite
Sulfides; nonmetallic:	molybdenite
metallic:	pyrite; chalcopyrite
Elements; nonmetallic:	graphite
metallic:	gold

b. Metamorphosed (additional to those of a, which may be recrystallized by metamorphism)

Orthosilicates; epidotes:	zoisite, piedmontite
hydroxy-:	chlorite (many varieties); kaolinite
Sulfates; hydroxy-:	alunite
Oxides; 1:2:	brookite, octahedrite
hydroxy-:	diaspore

c. Weathered

Silicon oxides:	quartz, chalcedony, opal
Orthosilicates; hydroxy-:	chlorite (many varieties); vermiculite (many varieties); kaolinite, chloropal, allophanite
Sulfates; hydrous-:	alunogen, halotrichite
hydroxy-:	jarosite
Phosphates; hydroxy-:	turquois
Oxides; hydroxy-:	bauxite, limonite, manganite, wad
Hydroxides:	gibbsite

I. 1. B. Alkalic Igneous Rocks

a. Primary

Silicon oxides:	(quartz)
Feldspars; orthoclases:	orthoclase, anorthoclase, microcline
plagioclases:	albite, oligoclase, andesine
Metasilicates; leucites:	leucite
pyroxenes:	acmite, ægirite
amphiboles:	hornblende, arfvedsonite, barkevikite, riebeckite, enigmatite
rare-earth-:	lovenite
Orthosilicates; garnets:	andradite
nephelites:	nephelite, cancrinite
sodalites:	sodalite, hauynite, noselite
melilites:	melilite
micas:	biotite
rare-earth-:	zircon

Orthosilicates; hydrous:	analcite
Phosphates; fluo- and chloro-:	apatite
Halides; fluorides:	villiaumite, fluorite
Oxides; double; spinels:	spinel (ceylonite) magnetite
rare-earth-:	ilmenite, perovskite
b. Metamorphosed (additional to those of a)	
Orthosilicates; miscellaneous:	ilvaite
micas:	muscovite
hydroxy-:	chlorite (many varieties)
Oxides; 1:2:	rutile
hydroxy-:	diaspore
c. Weathered	
Silicates; hydroxy-; zeolites:	hydronephelite, natrolite, thomsonite
misc.:	kaolinite
Oxides; hydroxy-:	bauxite; limonite
Hydroxides:	gibbsite

I. 1. C. Calcic Igneous Rocks

a. Primary	
Silicon oxides:	quartz
Feldspars; orthoclases:	orthoclase
plagioclases:	oligoclase, andesine, labradorite, bytownite, anorthite
Metasilicates; pyroxenes:	enstatite, hypersthene; diopside, augite; babingtonite
amphiboles:	hornblende; enigmatite, rhönite
hydrous-:	analcite

b. Metamorphosed (additional to those of a)[5]

Acid silicates; hydrous:	ptilolite, mordenite
Metasilicates; amphiboles:	grünerite, glaucophanite
hydrous:	pectolite; okenite, gyrolite, apophyllite; heulandite, brewsterite, epistilbite, phillipsite, harmotome, stilbite, gismondite, laumontite, laubanite, chabazite, gmelinite, levynite, faujasite, edingtonite, natrolite, mesolite, scolecite, zeophyllite
Orthosilicates; epidotes:	zoisite, piedmontite
boro-:	datolite
hydrous:	thomsonite, hydronephelite; lawsonite; prehnite
Carbonates:	calcite, aragonite
Sulfates:	anhydrite; gypsum
Silicate-sulfate-carbonates:	thaumasite
Oxides; 2:3:	hematite
Sulfides; 1:1:	galena, sphalerite
Elements; metallic:	copper, silver

c. Weathered

Oxides; hydroxy-:	limonite, bauxite
Hydroxides:	gibbsite
Silicates; hydroxy-:	chlorite (many varieties), kaolinite

I. 1. D. Magnesic Igneous Rocks

a. Primary

Feldspars; orthoclases:	(orthoclase)
plagioclases:	labradorite, bytownite
Metasilicates; pyroxenes:	enstatite, hypersthene, augite
Orthosilicates; garnets:	andradite, pyrope, uvarovite
chrysolites:	olivine, knebelite
Oxides; 2:3:	corundum
double; spinels:	spinel (picotite), magnetite, chromite
rare-earth-:	ilmenite; perovskite
Sulfides and arsenides; 1:1:	pyrrhotite, niccolite
misc.:	sperrylite, chalcopyrite

[5] Zeolite veins are regarded as belonging here.

Elements; nonmetallic:	diamond, graphite
metallic:	iron, nickel, palladium, osmium. iridium, iridosmine, platinum
b. Metamorphosed (additional to those of a)	
Metasilicates; pyroxenes:	jadeite
amphiboles:	anthophyllite; tremolite, asbestus. actinolite, hornblende
hydroxy:	talc
Orthosilicates; epidotes:	epidote
oxy-:	sillimanite
micas:	muscovite, margarite
hydroxy-:	chlorite (many varieties), serpentine, deweylite, sepiolite
Carbonates:	calcite, dolomite, ankerite
Oxides; 2:3:	corundum
double; spinels:	magnetite
c. Weathered	
Silicon oxides:	quartz, chalcedony, opal
Orthosilicates; hydroxy-:	chloropal, genthite
hydrous-:	allophanite
Oxides; hydroxy-:	limonite, diaspore
Hydroxides:	brucite
Carbonates; calcites:	calcite, magnesite
hydrous:	hydromagnesite, zaratite, remingtonite

Note.—Meteorites would be included here.

Sulfides; metallic; 1:1:	sphalerite, galena, pyrrhotite
1:2:	pyrite, arsenopyrite
double:	chalcopyrite, bornite, stannite
Elements; nonmetallic:	graphite
metallic:	bismuth, gold

b. Metamorphosed (additional to a)

Orthosilicates; nephelites:	eucryptite
epidotes:	zoisite
misc.:	bertrandite
hydrous:	pyrophyllite
Phosphates; hydroxy:	natrophilite, beryllonite, herderite, triploidite, hureaulite
hydrous:	dickinsonite, fillowite, fairfieldite, reddingite, eosphorite
Halides; single:	fluellite
double:	pachnolite, thomsenolite, prosopite, ralstonite, gearksutite

c. Weathered

Silicon oxides:	opal (hyalite)
Orthosilicates; hydroxy:	cookeite, chlorite, vermiculite, kaolinite
hydrous:	montmorillonite, uranophane
Carbonates; anhydrous:	bismutospherite
hydrous:	malachite, bismutite, lanthanite, tengerite, uranothallite, liebigite, voglite
fluo-:	bastnäsite
Oxides; hydroxy-:	limonite, manganite, gummite

Metasilicates; pyroxenes:	hedenbergite, augite; acmite, ægirite; schizolite
amphiboles:	arfvedsonite, enigmatite
rare-earth-:	rosenbuschite, lovenite, wöhlerite, hiortdahlite; eudialite, catapleiite, cappelenite, melanocerite, caryocerite, tritomite, elpidite
fluo-:	leucophanite, meliphanite
Orthosilicates; garnets:	andradite
nephelites:	nephelite; cancrinite
sodalites:	sodalite, noselite
helvites:	helvite
boron:	datolite, homilite
micas:	biotite, lepidomelane, zinnwaldite, tænolite
rare-earth-:	zircon, thorite; schorlomite; titanite; astrophyllite, johnstrupite, mosandrite, neptunite, keilhauite, benitoite, lorenzenite, rinkite
hydrous:	cenosite
Phosphates; rare-earth-:	xenotime
Columbates; isometric:	pyrochlore, chalcolamprite
orthorhombic:	polymignite
Borates:	nordenskioldine
Carbonates; calcites:	calcite
Halides; fluorides:	fluorite
Oxides; 2:3:	corundum
1:2:	baddeleyite
double; rare-earth-:	ilmenite
Sulfides and arsenides:	löllingite
b. Metamorphosed	
Silicates; micas:	muscovite
hydroxy-:	chlorite
Oxides; 1:2:	rutile
c. Weathered	
Silicates; hydroxy-:	kaolinite
hydrous; zeolites:	hydronephelite, analcite, natrolite, thomsonite
Carbonates; rare-earth fluo-:	ancylite, cordylite
Oxides; hydroxy-:	bauxite, limonite

I. 2. C. Calcic Pegmatites

a. Primary	
Silicon oxides:	(quartz)
Feldspars; orthoclases:	microcline
plagioclases:	albite, oligoclase, labradorite
Metasilicates; pyroxenes:	hypersthene; augite
amphiboles:	hornblende
Orthosilicates; garnets:	andradite
scapolites:	wernerite
boro-:	tourmaline
micas:	phlogopite, biotite
rare-earth-:	zircon; titanite
Phosphates; fluo- and chloro-:	apatite
Carbonates:	calcite
Halides; fluorides:	fluorite
Oxides; 1:2:	rutile
double; spinels:	magnetite
rare-earth-:	ilmenite
Sulfides; nonmetallic:	molybdenite
metallic; 1:1:	pyrrhotite
1:2:	pyrite
Elements; nonmetallic:	graphite
b. Metamorphosed	
Silicates; epidotes:	epidote
hydroxy-:	chlorite, kaolinite
c. Weathered	
Silicon oxides:	quartz, chalcedony, opal
[illegible]	[illegible]

Sulfates:	celestite, barite, gypsum
Tungstates:	scheelite, hübnerite, wolframite, ferberite, cuprotungstite
Halides; fluorides:	fluorite
Oxides:	hematite, uraninite, magnetite
Sulfides, arsenides, etc.; basic:	domeykite, algodonite, whitneyite, horsfordite, dyscrasite, chilenite, stützite, umangite, rickardite, maucherite, temiskamite, joseite, wehrlite
2:1 or 1:1:	argentite, hessite, petzite, galena, clausthalite, aguilarite, altaite, naumannite, berzelianite, lehrbachite, eucairite, zorgite, crookesite; chalcocite, stromeyerite, acanthite; sphalerite, metacinnabarite, tiemannite, onofrite, coloradoite, alabandite; cinnabar, covellite, greenockite, wurtzite, millerite, niccolite, breithauptite, pyrrhotite; realgar; polydymite, beyrichite
2:3:	orpiment, stibnite, bismuthinite, guanajuatite, tetradymite, melonite
1:2:	molybdenite; hauerite, pyrite, smaltite, chloanthite, cobaltite, gersdorffite, corynite, ullmannite, sperrylite, laurite, skutterudite, willyamite, marcasite, löllingite, arsenopyrite, safflorite, rammelsbergite, glaucodotite, alloclasite, kallilite, wolfachite; sylvanite, krennerite, nagyagite
double:	bornite, linnæite, cubanite, carrollite, chalcopyrite, stannite; sternbergite, chalmersite; teallite; sulvanite
sulfo-salts; acidic:	livingstonite, guejarite, chiviatite, cuprobismutite, rezbanyite

Sulfides, arsenides, etc.;		
sulfo-salts;	1:1:	zinkenite, andorite, sartorite, emplectite, chalcostibite, smithite, trechmannite, matildite, galenobismutite, berthierite, hutchinsonite, lorandite, miargyrite
	3:2:	plagionite, klaprotholite, baumhauerite, schirmerite, warrenite, dufrenoysite, cosalite, rathite, schapbachite, jamesonite, kobellite, brongniardite, semseyite, diaphorite, freieslebenite
	3:1:	bournonite, wittichenite, aikinite, boulangerite, lilianite, stylotypite, guitermanite, tapalpite; proustite, pyrargyrite; pyrostilpnite, rittingerite
	basic:	tennantite, tetrahedrite, jordanite, meneghinite, geocronite, stephanite, kilbrickenite, beegerite, pearcite, polybasite, polyargyrite
	arsenates, etc.:	enargite, famatinite, xanthoconite, epiboulangerite, epigenite, canfieldite, argyrodite, franckeite, cylindrite

[redacted]

Carbonates; hydroxy-:	malachite, azurite, hydrozincite, aurichalcite, hydrocerussite, bismutite, liebigite, voglite
Phosphates and arsenates;	
chloro-:	pyromorphite, mimetite, vanadinite
hydrous-:	libethenite, olivenite, adamite, descloizite, brackebuschite, psittacinite, dihydrite, erinite, pseudomalachite, clinoclasite, arseniosiderite, atelestite, roselite, trichalcite, hopeite, vivianite, erythrite, annabergite, cabrerite, köttigite, scorodite
hydroxy-:	parahopeite, haidingerite, pharmacolite, forbesite, conichalcite, bayldonite, tagilite, leucochalcite, euchroite, cornwallite, tyrolite, chalcophyllite, ludlamite, wavellite, liskeardite, pharmacosiderite, mazapilite, liroconite, chenevixite, chalcosiderite, trogerite, plumbogummite
double UO_2-:	autunite, uranocircite, torbernite, uranospinite, zeunerite, walpurgite, rhagite, mixite
Nitrates:	gerhardtite
Arsenites, antimonites:	trippkeite, pitticite
Uranates:	uranospherite, gummite
Antimonates:	bindheimite
Tungstates:	powellite, stolzite, wulfenite, raspite, molybdite
Sulfates; anhydrous:	barite, anglesite, crocoite, phœnicochroite, vauquelinite
basic (oxy-):	lanarkite
chloro-:	caracolite, connellite, spangolite, leadhillite
hydrous-:	gypsum, ilesite, epsomite, goslarite, morenosite, melanterite, mallardite, pisanite, bieberite, chalcanthite, kröhnkite, römerite, boothite.

Sulfates; hydroxy-:	caledonite, **brochantite**, linarite, langite, **herrengrundite**, cyanotrichite, **serpierite**, castanite, copiapite, **knoxvillite**, utahite, amarantite, **fibroferrite**, glockerite, **felsobanyite**, botryogen, quetenite, **zincaluminite**
Tellurates, etc.:	montanite, **emmonsite**, durdenite, chalcomenite
Halides; simple:	calomel, **marshite**, miersite, nantokite, **cerargyrite**, embolite, **bromyrite**, iodyrite, cotunnite, **cuproiodargyrite**
oxy-:	matlockite, **schwartzembergite**, laurionite, **paralaurionite**, penfieldite, **daviesite**, fiedlerite, atacamite, **egglestonite**, terlinguaite, kleinite
Oxides; 2:1:	cuprite
1:1:	manganosite, **bunsenite**, tenorite, montroydite, **massicot**
2:3:	arsenolite, **senarmontite**, claudetite, **valentinite**, bismite; hematite
1:2:	tellurite, **cervantite**, stibiconite, pyrolusite, **plattnerite**
1:3:	tungstite
double:	minium

Sulfates; hydrous:	epsomite, boussingaultite, mirabilite, gypsum, picromerite, cyanochroite, coquimbite, alunogen, voltaite, metavoltine
Halides; anhydrous:	halite, sylvite, sal-ammoniac, hydrophilite, chloromagnesite, scacchite, molysite, hieratite, cotunnite
oxy-:	matlockite, nocerite
hydrous:	kremersite, erythrosiderite
Oxides; 1:1:	tenorite, massicot
2:3:	hematite
double:	magnesioferrite
Hydroxides:	sassolite
Sulfides:	realgar, cinnabar, hauerite
Elements:	sulfur, selen-sulfur

II. 1. A. Siliceous (and Argillaceous) Sediments

a. Primary

Silicon oxides:	quartz, chalcedony
Feldspars:	orthoclase; albite
Metasilicates:	augite, hornblende
Orthosilicates; garnets:	almandite
olivines:	olivine
boro-:	tourmaline
micas:	muscovite, biotite
oxy-:	cyanite
hydroxy-:	staurolite, epidote
rare-earth-:	zircon; titanite
misc.:	glauconite
Phosphates; rare-earth-:	monazite, xenotime
fluo-:	apatite
Antimonates:	tripuhyite, lewisite, derbylite
Oxides; 2:3:	corundum, hematite
1:2:	rutile, cassiterite, baddeleyite
double; spinels:	spinel, magnetite, chromite
rare-earth-:	ilmenite, senaite
Elements; nonmetallic:	diamond, graphite
metallic:	copper, silver, gold, palladium, osmium, iridium, platinum

b. Metamorphosed

Silicon oxides:	quartz
Feldspars:	orthoclase; microcline; albite
Metasilicates:	hornblende, glaucophanite, croci-dolite, iolite
Orthosilicates; garnets:	almandite
boro-:	tourmaline, dumortierite
micas:	muscovite, paragonite, biotite, chloritoid
oxy-:	cyanite, sillimanite, andalusite
epidotes:	zoisite, epidote, piedmontite
hydroxy-:	staurolite
rare-earth-:	zircon; titanite
Phosphates; fluo-:	apatite
Oxides; 2:3:	corundum, hematite
1:2:	rutile
double; spinels:	spinel, magnetite, hercynite
rare-earth-:	ilmenite
Sulfides:	pyrite, molybdenite
Elements; nonmetallic:	graphite

c. Weathered

Silicates; hydroxy:	kaolinite
Sulfates; hydrous:	alunogen, kalinite, halotrichite, carphosiderite
Phosphates, etc.:	carnotite

II. 1. B. Calcareous (and Magnesian) Sediments

a. Primary

Metasilicates; amphiboles:	tremolite, edenite, hornblende
Orthosilicates: garnets:	grossularite, andradite, uvarovite
nephelites:	kaliophilite, microsommite
sodalites:	lazùrite
chrysolites:	monticellite, forsterite
scapolites:	meionite, wernerite, mizzonite, marialite, sarcolite
melilites:	melilite, gehlenite, fuggerite
vesuvianites:	vesuvianite
epidotes:	zoisite, epidote
hydroxy-:	ilvaite
boro-:	danburite, tourmaline, axinite, serendibite
fluo-:	prolectite, humite, chondrodite, clinohumite, cuspidine
micas:	phlogopite, biotite
rare-earth-:	zircon; titanite, guarinite
hydrous-:	chlorites (several varieties), hillebrandite; glauconite, pholidolite
carbonate-:	spurrite
Phosphates; fluo-:	apatite
Columbates:	columbite
Borates:	warwickite, colemanite
Halides; fluorides:	fluorite
Oxides; 1:1:	periclasite
2:3:	corundum
double; spinels:	spinel (several varieties), magnetite
rare-earth-:	ilmenite
Sulfides:	pyrrhotite, molybdenite, pyrite
Elements; nonmetallic:	graphite, sulfur
c. Weathered	
Sulfates:	barite, gypsum
Carbonates:	calcite, aragonite
Nitrates:	nitromagnesite, nitrocalcite

II. 1. C. Ferruginous (also Manganiferous and Zinciferous) Sediments

a. Primary	
Silicon oxides:	(quartz)
Silicates:	glauconite

Carbonates:	ankerite, siderite
Oxides; 2:3:	hematite
1:2:	polianite, pyrolusite
double:	magnetite, hausmannite, braunite
hydroxy-:	bauxite, manganite, limonite, goethite, xanthosiderite, turgite
hydroxides:	psilomelane (including varieties)

b. Metamorphosed[6]

Silicon oxides:	quartz
Feldspars:	microcline, albite, oligoclase, celsian
Metasilicates; pyroxenes:	augite, schefferite, jeffersonite, urbanite, rhodonite
amphiboles:	hornblende
barysilites:	barysilite, ganomalite, hardystonite, hyalotekite
Orthosilicates; garnets:	andradite, spessartite
nephelites:	nasonite
chrysolites:	tephroite, roepperite, glaucochroite
phenakites:	trimerite, willemite, pyrosmalite
epidotes:	piedmontite, hancockite
misc.:	harstigite, melanotekite, molybdophyllite
hydroxy-:	clinohedrite, roeblingite, leucophoenicite, bementite, karyopilite, neoticite

	siderite, synadelphite, flinkite, hematolite, arseniopleite, manganostibiite, sarkinite, chondrarsenite, cirrolite, cacoxenite, beraunite, calcioferrite, borickite, wardite, zepharovichite
Borates:	sussexite, pinakiolite
Oxides; 1:1:	manganosite, zincite
2:3:	hematite
double; spinels:	magnetite, franklinite, gahnite, jacobsite
misc.:	longbanite
c. Weathered	
Silicon oxides:	quartz, chalcedony
Silicates:	calamine, friedelite, chloropal
Carbonates:	rhodochrosite, smithsonite, hydrozincite
Oxides; hydroxy-:	limonite
Hydroxides:	chalcophanite, pyrochroite

II. 1. D. Saline Sediments

a. Primary	
Carbonates; calcites:	calcite, dolomite
aragonites:	aragonite, strontianite
double; hydrous:	natron, gaylussite, trona, pirssonite
chloro-, etc.:	northupite, tychite, hanksite, kainite, sulfohalite
Sulfates; anhydrous:	anhydrite, celestite, barite; thenardite, aphthitalite, langbeinite, glauberite, vanthoffite
simple, hydrous:	mirabilite, kieserite, epsomite, gypsum
double, hydrous:	leonite, blödite, löweite, picromerite, natrochalcite, syngenite, pickeringite, boussingaultite
Borates; anhydrous:	boracite
simple, hydrous:	borax, pinnoite, ascharite, larderellite, lagonite, bechilite, ulexite, hydroboracite, heintzite
sulfo-:	sulfoborite

Aurichalcite: I. 3. c.
Autunite: I. 2. A. c.
Axinite: I. 2. A. a.; II. 1. B. b.
Azurite: I. 3. c.

B

Babingtonite: I. 1. C. a.; II. 1. B. b.
Baddeylite: I. 2. B. a.; II. 1. A. a.
Bakerite: II. 1. D. a.
Barite: I. 3. a, c.; II. 1. B. a.;
II. 1. D. a.
Barkevikite: I. 1. B. a.
Barrandite: II. 1. C. b.
Barysilite: II. 1. C. b.
Barytocalcite: II. 1. D. a.
Bastnäsite: I. 2. A. c.
Bathvillite: II. 1. F. b.
Baumhauerite: I. 3. a.
Bauxite: I. 1. A. c.; I. 1. B. c.;
I. 1. C. b, c.; II. 1. C. a.
Bayldonite: ?
Bechilite: II. 1. D. a.
Beckelite: ?
Beegerite: I. 3. a.
Belonesite: ?
Bementite: II. 1. C. b.
Benitoite: I. 2. B. a.
Beraunite: II. 1. C. b.
Berthierite: I. 3. a.
Bertrandite: I. 2. A. b.
Beryl: I. 2. A. a.
Beryllonite: I. 2. A. b.
Berzelianite: I. 3. a.
Berzeliite: II. 1. C. b.
Beudantite: II. 1. C. b.
Beyrichite: I. 3. a.
Bieberite: I. 3. c.
Bindheimite: I. 3. c.
(Binnite: doubtful species.)
Biotite: I. 1. A. a.; I. 1. B. a.;
I. 1. C. a.; I. 2. A. a.; I. 2. B. a.;
I. 3. a.; II. 1. A. a, b.; II. 1. B. b.

Brackebuschite: I. 3. c.
Brandtite: II. 1. C. b.
Braunite: II. 1. C. a.
Breithauptite: I. 3. a.
Brewsterite: I. 1. C. b.
Brochantite: I. 3. c.
Bromlite: I. 3. a.
Bromyrite: I. 3. c.
Brongniardite: I. 3. a.
Brookite: I. 1. A. b.; I. 2. A. a.
Brucite: I. 1. D. c.
Brugnatellite: ?
Brushite: II. 1. E. b.
Bunsenite: I. 3. c.
Bytownite: I. 1. C. a.; I. 1. D. a.

C

Cabrerite: I. 3. c.
Cacoxenite: II. 1. C. b.
Calamine: I. 3. c.; II. 1. C. c.
Calcioferrite: II. 1. C. b.
Calciovolborthite: ?
Calcite: I. 1. C. b.; I. 1. D. b, c.;
I. 2. A. a.; I. 2. B. a.; I. 2. C. a.;
I. 3. a, c.; II. 1. B. a, b, c.;
II. 1. D. a.
Caledonite: I. 3. c.
Callainite: II. 1. C. b.
Calomel: I. 3. c.
Cancrinite: I. 1. B. a.; I. 2. B. a.
Canfieldite: I. 3. a.
Capellenite: I. 2. B. a.
Caracolite: I. 3. c.
Carminite: II. 1. C. b.
Carnallite: II. 1. D. a.
Carnotite: II. 1. A. c.
Carpholite: I. 2. A. a.
Carphosiderite: II. 1. A. c.
Carrolite: I. 3. a.
Caryinite: II. 1. C. b.
Caryocerite: I. 2. B. a.
Caryopilite: see Karyopilite.

Chalcocite: I. 3. a, b.
Chalcolamprite: I. 2. B. a.
Chalcomenite: I. 3. c.
Chalcophanite: I. 3. c.; II. 1. C. c.
Chalcophyllite: I. 3. c.
Chalcopyrite: I. 1. A. a.; I. 1. C. a.; I. 1. C. b.; I. 1. D. a.; I. 2. A. a.; I. 3. a.
Chalcosiderite: I. 3. c.
Chalcostibite: I. 3. a.
Chalmersite: I. 3. a.
Chenevixite: I. 3. c.
Childrenite: I. 2. A. a.
Chilenite: I. 3. a.
Chiolite: I. 2. A. a.
Chiviatite: I. 3. a.
Chloanthite: I. 3. a.
Chlorite: I. 1. A. b, c.; I. 1. B. b.; I. 1. C. b.; I. 1. D. b.; I. 2. A. c.; I. 2. B. b.; I. 2. C. b. Includes aphrosiderite, clinochlore, delessite, diabantite, penninite, prochlorite, strigorite.
Chloritoid: II. 1. A. b.
Chloromagnesite: I. 4.
Chloromanganokalite: ?
Chloropal: I. 1. A. c.; II. 1. C. c. Includes nontronite.
Chondroarsenite: II. 1. C. b.
Chondrodite: II. 1. B. b.
Chromite: I. 1. D. a.; II. 1. A. a.
Chrysoberyl: I. 2. A. a.
Chrysocolla: I. 3. c.
Chrysolite: see olivine.
Chrysotile: see serpentine.
Churchite: ?
(**Cimolite**: doubtful species.)
Cinnabar: I. 3. a.; I. 4.
Cirrolite: II. 1. C. b.
Claudetite: I. 3. c.
Clausthalite: I. 3. a.
Clinochlore: see chlorite.
Clinoclasite: I. 3. c.
Clinohedrite: II. 1. C. b.
Clinohumite: II. 1. B. b.
Coal: II. 1. F. b.
Cobaltite: I. 3. a.
Colemanite: II. 1. B. b.
Collophanite: II. 1. E. b.
(**Collyrite**: doubtful species.)
Coloradoite: I. 3. a.
Columbite: I. 2. A. a.
Conichalcite: I. 3. c.
Connarite: ?
Connellite: I. 3. c.
Cookeite: I. 2. A. c.
Copiapite: I. 3. c.
Copper: I. 1. C. b.; I. 3. a, c.; II. 1. A. a.
Coquimbite: I. 4.
Cordylite: I. 2. B. c.
Cornwallite: I. 3. c.
(**Corundophyllite**: doubtful species.)
Corundum: I. 1. A. a.; I. 1. D. a, b.; I. 2. A. a.; I. 2. B. a.; II. 1. A. a, b.; II. 1. B. b.
Corynite: I. 3. a.
Cosalite: I. 3. a.
Cotunnite: I. 3. c.; I. 4.
Covellite: I. 3. a, b.
Crednerite: ?
Cristobalite: I. 1. C. a.
Crocidolite: II. 1. A. b.
Crocoite: I. 3. c.
Cronstedtite: I. 3. a.
Crookesite: I. 3. a.
Cryolite: I. 2. A. a.
Cryolithionite: I. 2. A. a.
Cubanite: I. 3. a.
Cuprite: I. 3. c.
Cuprobismutite: I. 3. a.
Cuproiodargyrite: I. 3. c.
Cuprotungstite: I. 3. a.
Cuspidine: II. 1. B. b.
Cyanite: I. 2. A. a.; II. 1. A. a, b.
Cyanochroite: I. 4.
Cyanotrichite: I. 3. c.
Cylindrite: I. 3. a.
Cyprusite: ?

D

Dahllite: ?
Danalite: see helvite.
Danburite: II. 1. B. b.
(**Daphnite**: doubtful species.)
Darapskite: II. 1. D. a.
Datolite: I. 1. C. b.; I. 2. A. a.; I. 2. B. a.
Daubreeite: ?
Daubreelite: meteoritic.
Daviesite: I. 3. c.
Dawsonite: ?
Delessite: see chlorite.
Delorenzenite: ?
Derbylite: II. 1. A. a.
Descloizite: I. 3. c.
Deweylite: I. 1. D. b.
Diabantite: see chlorite.
(**Diadochite**: doubtful species.)
Diamond: I. 1. D. a.; II. 1. A. a.
Diaphorite: I. 3. a.
Diaspore: I. 1. A. b.; I. 1. B. b.
Dickinsonite: I. 2. A. b.
Dietrichite: ?
Dietzite: II. 1. D. a.
Dihydrite: I. 3. c.
Diopside: I. 1. C. a.; II. 1. B. b.
Dioptase: I. 3. c.
Dolerophanite: I. 4.
Dolomite: I. 1. D. b.; I. 3. a.; II. 1. B. a, b, c.; II. 1. D. a.
Domeykite: I. 3. a.

Pentlandite: I. 1. C. a.
Percylite: ?
Periclasite: II. 1. B. b.
Perovskite: I. 1. B. a.; I. 1. C. a.; I. 1. D. a.
Petalite: I. 2. A. a.
Petroleum: II. 1. F. b.
Petzite: I. 3. a.
Pharmacolite: I. 3. c.
Pharmacosiderite: I. 3. c.
Phenakite: I. 2. A. a.
Phillipsite: I. 1. C. b.
Phlogopite: I. 2. C. a.; II. 1. B. b.
Phœnicochroite: I. 3. c.
Pholidolite: II. 1. B. b.
Phosgenite: I. 3. c.
Phosphorite: II. 1. E. a.
Phosphosiderite: II. 1. C. b.
Phosphuranylite: I. 2. A. c.
Pickeringite: II. 1. D. a.
Picotite: I. 1. D. a.
Picromerite: I. 4.; II. 1. D. a.
Picropharmacolite: ?
Piedmontite: I. 1. A. b.; I. 1. C. b.; II. 1. A. b.; II. 1. C. b.
Pinakiolite: II. 1. C. b.
Pinnoite: II. 1. D. a.
Pirssonite: II. 1. D. a.
Pisanite: I. 3. c.
Pistomesite: ?
Pitticite: I. 3. c.
Plagionite: I. 3. a.
Platinum: I. 1. D. a.; II. 1. A. a.
Plattnerite: I. 3. c.
Plumbogummite: I. 3. c.
Polianite: II. 1. C. a.
Pollucite: I. 2. A. a.
Polyargyrite: I. 3. a.
Polybasite: I. 3. a, b.
Polycrase: I. 2. A. a.
Polydymite: I. 3. a.

Pyroaurite: I. 1. D. b.
Pyrochlore: I. 2. B. a.
Pyrochroite: II. 1. C. c.
Pyrolusite: II. 1. C. a.
Pyromorphite: I. 3. c.
Pyrope: I. 1. D. a.; I. 2. A. a.
Pyrophyllite: I. 2. A. b.
Pyrosmalite: II. 1. C. b.
Pyrostilpnite: I. 3. a.
Pyroretinite: II. 1. F. b.
Pyroxene: see augite, diallage, diopside, hedenbergite, jeffersonite, schefferite.
Pyrrhotite: I. 1. C. a.; I. 1. D. a.; I. 2. A. a.; I. 2. C. a.; II. 1. B. b.

Q

Quartz: I. 1. A. a, c.; I. 1. B. a.; I. 1. C. a.; I. 1. D. c.; I. 2. A. a.; I. 2. B. a.; I. 2. C. a, c.; I. 3. a, c.; II. 1. A. a, b.; II. 1. B. a.; II. 1. C. a, b, c.
Quenstedtite: ?
Quetenite: I. 3. c.

R

Raimondite: ?
Ralstonite: I. 2. A. b.
Rammelsbergite: I. 3. a.
Raspite: I. 3. c.
Rathite: I. 3. a.
Realgar: I. 3. a.; I. 4.
Reddingite: I. 2. A. b.
Reinite: ?
Remingtonite: I. 1. D. c.
Retzian: II. 1. C. b.
Rezbanyite: I. 3. a.
Rhabdophanite: ?
Rhagite: I. 3. c.

Tennantite: I. 3. a.
Tenorite: I. 3. c.; I. 4.
Tephroite: II. 1. C. b.
Terlinguaite: I. 3. c.
Teschemacherite: II. 1. E. b.
Tetradymite: I. 3. a.
Tetrahedrite: I. 3. a.
Thalenite: I. 2. A. a.
Thaumasite: I. 1. C. b.
Thenardite: II. 1. D. a.
Thermonatrite: II. 1. D. a.
Thomsenolite: I. 2. A. b.
Thomsonite: I. 1. C. b.; I. 2. B. c.
Thorianite: I. 2. A. a.
Thorite: I. 2. A. a.
Thulite: II. 1. A. b.
Thuringite: II. 1. B. b.
Tiemannite: I. 3. a.
Tilasite: II. 1. C. b.
Tin: ?
Titanite: I. 1. A. a.; I. 1. C. a.; I. 2. A. a.; I. 2. B. a.; I. 2. C. a.; II. 1. A. a.; II. 1. B. b.
Topaz: I. 1. A. a.; I. 2. A. a.
Torbernite: I. 2. A. c.; I. 3. c.
Tourmaline: I. 1. A. a.; I. 2. A. a.; I. 2. C. a.; I. 3. a.; II. 1. A. a, b.; II. 1. B. b.
Trechmannite: I. 3. a.
Tremolite: I. 1. D. b.; II. 1. B. b.
Trichalcite: I. 3. c.
Tridymite: I. 1. A. a.; I. 1. C. a.
Trimerite: II. 1. C. b.
Triphyllite: I. 2. A. a.
Triplite: I. 2. A. a.
Triploidite: I. 2. A. b.
Trippkeite: I. 3. c.
Tripuhyite: II. 1. A. a.
Tritomite: I. 2. B. a.
Trögerite: I. 3. c.
Troilite: meteoritic.
Trona: II. 1. D. a.

Uranothallite: I. 2. A. c.
Urbanite: II. 1. C. b.
Utahite: I. 3. c.
Uvarovite: I. 1. D. a.

V

Valentinite: I. 3. c.
Vanadinite: I. 3. c.
Vanthoffite: II. 1. D. a.
Variscite: ?
Vauquelinite: I. 3. c.
Vermiculite: I. 1. A. c.; I. 2. A. c. Includes jefferisite.
Vesuvianite: II. 1. B. b.
Veszelyite: ?
Villiaumite: I. 1. B. a.
Vivianite: I. 3. c.; II. 1. C. b.
Voglite: I. 3. c.
Volborthite: ?
Voltaite: I. 4.
Voltzite: I. 3. c.

W

Wad: see psilomelane.
Wagnerite: ?
Walpurgite: I. 3. c.
Wapplerite: ?
Wardite: II. 1. C. b.
Warrenite: I. 3. a.
Warwickite: II. 1. B. b.
Wattevillite: ?
Wavellite: I. 3. c.; II. 1. C. b.
Wehlerite: I. 3. a.
Wellsite: ?
Wernerite: I. 2. A. a.; I. 2. C. a.; II. 1. B. b.
Whewellite: II. 1. F. c.
Whitneyite: I. 3. a.
Willemite: II. 1. C. b.
Willyamite: I. 3. a.

NEW OR LITTLE-KNOWN CRANE-FLIES FROM THE UNITED STATES AND CANADA: TIPULIDÆ, DIPTERA. PART 2.

BY CHARLES P. ALEXANDER.

INTRODUCTION.

In the present paper, the author has undertaken a consideration of the American crane-flies contained in the collections of the Boston Society of Natural History and the Museum of Comparative Zoology at Cambridge. These collections are of peculiar interest to the student of crane-flies since they include the numerous types of Johnson, Osten Sacken, and Loew, in addition to a considerable amount of unclassified material. The paper has been divided into two parts, the first being a designation of the single-type specimen of the species of *Tipula* described by Loew, the second part a continuation of the first paper under this title.[1] I wish to express my deep appreciation to all of the persons who have kindly assisted me in this study, most of whom are designated in various parts of the paper. I am especially indebted to Mr. Charles W. Johnson and to Mr. Samuel Henshaw for the great privilege of examining and studying the invaluable collections in their custody.

PART 1. DESIGNATION OF THE SINGLE-TYPE (LECTOTYPIC) SPECIMEN OF THE NORTH AMERICAN SPECIES OF TIPULA DESCRIBED BY HERMANN LOEW.

Century IV, vol. 7, Nos. 1–42; 1863.
Century V, vol. 8, Nos. 14–32; 1864.
Century VI, vol. 9, Nos. 2, 3; 1865.
Century VIII, vol. 13, No. 2; 1869.
Century X, vol. 16, Nos. 2, 3; 1872.

All of the North American crane-flies described by Loew in this series of articles belong to the subfamily *Tipulinæ* and include the following genera: *Ctenophora* (1 species); *Longurio* (1 species); *Holorusia* (1 species); *Stygeropsis* (3 species); *Pachyrrhina* (19 species) and *Tipula* (41 species). The Loew material is all cotypic, there being no designation of a single-type specimen, and consequently the choosing of a lectotype at this time is deemed advisable. Concerning the Loew collection, as it is now preserved, it should be understood that the type-series for any species very often includes many specimens that were not mentioned by Loew in his original description, and yet there can be no doubt but that the material formed part of the type-series, since the specimens often bear the written label in Loew's script and the text of certain of the descriptions indicates that this material was before the author at the time that the description was drawn up. It has often seemed advisable to select one of these latter specimens as type, but this has not been done unless the actual specimen mentioned by Loew could not be located, as in the case of *Tipula angulata*. In all cases the male sex has been given preference over the female because of the varied characters of the hypopygium of this sex. Specimens that were placed in the series by Osten Sacken at the time that he arranged the material in the museum, but from the place and date were obviously not in Loew's hands at the time of the drawing up of the descriptions, have been ignored. It may be stated that the material in the Museum of Comparative Zoology, as regards the species of *Tipula*, is still largely unarranged except to the major divisions based on the wing-pattern, there being three large cases devoted to the *striatæ*, *marmoratæ* and *subunicolores*. When one studies the descriptions of the *Tipulæ* described by Loew it is at once noted that only about six of the forty or more characterized are of the *subunicolores*, and this was explained when the collection was studied. The majority of the species described as new in the present paper, as well as most of the Eastern species named by Doane in 1901, were found in the collection, bearing manuscript names in Loew's writing but for some unexplained reason having never been described. In cases where this was feasible the name suggested by Loew is the

one that has been adopted. These manuscript names of Loew have appeared in various collections, or, in some cases (*bicornis*, *brevicollis*), even into the literature, and consequently it is deemed advisable to mention the name applied by Loew to the different species discussed in the second part of this paper.

TIPULA.

T. angulata, Century V, No. 22, pp. 61, 62.

The type-material was stated to have come from Massachusetts, but the only specimen now appearing in the collection is a male from New Hampshire, bearing the number 258, with the name-label in Loew's writing. It is this specimen that is designated as the type; there is a possibility that the locality labels were later confused or that Loew wrote down the wrong State in his original description. There is no reason whatsoever for doubting that the specimen was before Loew at the time he drew up the description. The paler specimen mentioned in a note by Loew is not of this species, but of *T. penobscot*, described later; the sex is not female, but male.

Lectotype, ♂, New Hampshire.

T. angustipennis, Century IV, No. 19, pp. 286, 287.

Seventeen specimens in the type-series; (1), ♂, Winnipeg (Kennicott); (2), ♂, No. 396, Labrador (Schneider); (3), ♀, No. 129, Connecticut; (4), ♂, Maine. Others in the series from Illinois; Hudsons Bay Territory (Kennicott); Lake Superior; Texas; Brunswick, Maine (Packard).

Lectotype, ♂, Winnipeg (Kennicott).

T. apicalis, Century IV, No. 2, p. 277.

Three specimens in the type-series; (1), ♀, bearing the name-label

T. fragilis, Century IV, No. 7, pp. 279, 280.

Two specimens in the type-series; (1), ♂, No. 7, Maine.

Lectotype, ♂, Maine.

T. fraterna, Century V, No. 14, pp. 56, 57.

The type is apparently no longer in existence. A label pinned in the case states: "I found the label loose in the drawer and could not refer it to any species. O. Sacken." The species was described from the District of Columbia (Osten Sacken).

T. grata, Century IV, No. 11, pp. 281, 282.

Six specimens in the type-series; (1), two ♂'s, District of Columbia (Osten Sacken); (3), ♂ ♀, New York.

Lectotype, ♂, District of Columbia (Osten Sacken).

T. hebes, Century IV, No. 18, pp. 285, 286.

Six specimens in the type-series; (1), ♂, the specimen bearing the name-label in Loew's writing lacks the locality-label, but is presumably the Connecticut specimen; (2), ♂, Wisconsin; (3), ♀'s, Illinois. The Maine material was not found.

Lectotype, ♂, Connecticut (Norton).

T. ignobilis, Century IV, No. 9, p. 280.

Two specimens in the type-series; (1), ♀, without locality-label, but presumably the specimen from the District of Columbia; the specimen is pinned with the cast pupal skin; (2), ♀, New Hampshire.

Lectotype, ♀, District of Columbia (Osten Sacken).

T. infuscata, Century IV, No. 26, pp. 289, 290.

Two specimens in the type-series; (1), the specimen bearing the name-label is broken and the sex is uncertain, but from the text of the original characterization it is presumed that the specimen is a

with the apex of the abdomen broken off; the specimen bears the name-label in Loew's writing; (5), ♀, Maine.

Lectotype, ♂, Illinois (description says Osten Sacken, but probably Kennicott).

T. macrolabis, Century V, No. 17, p. 58.

Two specimens in the type-series; (1), ♂, No. 136, Fort Resolution (Kennicott) (2), ♂, labelled "Hudsons Bay Territory."

Lectotype, ♂, Fort Resolution, Hudsons Bay Territory (Kennicott).

T. pallida, Century IV, No. 16, pp. 284, 285.

Six specimens in the type-series; (1), ♂, No. 251, pinned above the cast pupal skin, Massachusetts; (2), ♂, Massachusetts; (3), ♀, New Hampshire; (4), sex uncertain, New Hampshire; (5), two ♂'s, without locality-labels, bearing the numbers 155, 162, respectively.

Lectotype, ♂, Massachusetts (Scudder).

T. praecisa, Century X, No. 2, p. 51.

The type-material is from California.

Lectotype, ♂, California (Hy. Edwards).

T. pubera, Century V, No. 16, pp. 57, 58.

The type-material is from California.

Lectotype, ♂, California (A. Agassiz).

T. septentrionalis, Century IV, No. 4, p. 278.

Three specimens in the series; (1), ♂, No. 394, Labrador; (2), two ♂'s, one bearing the name-label.

Lectotype, ♂, Labrador (Schneider).

T. serrulata, Century V, No. 18, pp. 58, 59.

The monotype only, a ♀, Fort Resolution, Hudsons Bay Territory (Kennicott).

T. serta, Century IV, No. 14, p. 283.

Twelve specimens in the type-series; (1), ♂, No. 382, without locality-label, but probably from English River, Canada; (2), ♂, No. 18, without locality-label; (3) several others, English River, Canada (Kennicott); (7), other specimens, Winnipeg (Kennicott); (10), Massachusetts (Scudder), these latter specimens almost entirely destroyed by Dermestids.

Lectotype, ♂, English River, Canada (Kennicott).

T. speciosa, Century IV, No. 22, p. 288.

Six specimens in the type-series; (1), ♂, Illinois; (2), ♂, No. 256, District of Columbia; (3), ♂'s, New Jersey; (5), ♂, Kentucky,

this last specimen accompanied by a note "last joint of the antennæ very small in both ♂ ♀; 2nd joint of palpi = 3rd," in Osten Sacken's writing.

Lectotype, ♂, Illinois (description says Osten Sacken, but probably Kennicott).

T. **strepens**, Century IV, No. 28, p. 291.

Three specimens in the type-series: (1), ♀, No. 253, without locality-label, presumably New York; (2), two ♀'s, Palisades, New York (O. Sacken). The male of the original description could not be located.

Lectotype, ♀, New York (Osten Sacken).

T. **subfasciata**, Century IV, No. 13, p. 282, 283.

Two specimens in the type-series; sex uncertain, but the original description says ♂.

Lectotype, ♂, English River, Canada (Kennicott).

T. **submaculata**, Century IV, No. 23, p. 288.

Three specimens in the type-series; (1), ♀, Massachusetts; (2), ♀, No. 259, New York. The male was not included in the original description, but appears in the collection under the manuscript name "*bidens.*"

Lectotype, ♀, Massachusetts (Scudder).

T. **suspecta**, Century IV, No. 8, p. 280.

The monotype only, a ♀, without locality-label; the description says District of Columbia (Osten Sacken).

T. **tephrocephala**, Century V, No. 23, p. 62.

Seven specimens in the type-series; (1), ♂, No. 180, bearing the name-label, New Hampshire; (2), ♀, New Hampshire; (3), ♀,

T. tesselata, Century IV, No. 3, pp. 277, 278.

The monotype only, a ♀, Labrador (Schneider).

T. umbrosa, Century IV, No. 31, p. 292.

The monotype only, a ♂, Louisiana (Schaum).

T. valida, Century IV, No. 21, pp. 287, 288.

Eight specimens in the type-series; (1), ♀, No. 293, Illinois; (2), ♂, Virginia. The male sex is not mentioned in the original description. The Massachusetts specimens have lost the locality-labels.

Lectotype, ♀, Illinois.

T. versicolor, Century IV, No. 17, p. 285.

The monotype only, a ♀, Illinois, bearing the label "*versicolor* m."

PART 2. DESCRIPTION OF NEW OR LITTLE-KNOWN SPECIES.

Family TIPULIDÆ.

Sub-family TIPULINÆ.

Tribe Tipulini.

NEPHROTOMA Meigen.

Pales Meigen; Nouvelle Classification des Mouches, p. 14; 1800 (*nomen nudem*).
Nephrotoma Meigen; Illiger's Magazine, p. 262; 1803.
Pachyrrhina Macquart; Histoire Naturelle des Insectes; Dipteres I, p. 88; 1834.

The genus *Nephrotoma* was erected by Meigen in 1803 to include the Fabrician species, *dorsalis*. The insect mentioned, specimens of which are before me (Urdingen, Niederrhein, Germany; Riedel, collector), is a typical *Pachyrrhina* of the same group as *eucera* Loew (Nearctic). The venational details and the characters of the male hypopygium are altogether of the nature of those occurring in *Pachyrrhina*. Loew, in a foot-note to the characterization of *eucera* (*Berliner Entomologische Zeitschrift*, VII, Century 4, p. 297; 1863) states that if *Nephrotoma* is to be separated from *Pachyrrhina*, *eucera* should be referred to *Nephrotoma*. The antennæ of *eucera* and *dorsalis* are 19-segmented in the male; of *polymera*, 16-segmented in the male; of the majority of the species of the genus, 13-segmented in the male. Thus we see there is a very considerable range in the number of antennal segments, but the species included are all so very similar in the details of venation, in the male hypopygia and in their general habitus and body-coloration that they should not be separated, especially since the females show a very much lesser range in the number of antennal segments (13 to 15). A considerable

variation in the number of antennal segments is found in other genera of crane-flies (*Ctedonia*, 15 to 24 segments; *Cerozodia*, 32 to 39 segments; *Tanyderus*, 17 to 25 segments), and consequently too much significance should not be placed upon this variable character in these groups.

The genus *Pachyrrhina* was described at a much later date, and consequently the numerous species known throughout the world under this name must be referred to *Nephrotoma*. The change in the American species affects all of the described forms with the exception of *collaris* Say, *polymera* Loew, *nobilis* Loew, *unimaculata* Loew, *californica* Doane, *trinidadensis* Alexander and *macrosterna* Alexander, which should be referred to the genus *Tipula* as discussed below.

The discovery of an ultimate character to separate the species of *Nephrotoma* from those of *Tipula* is still largely a desideratum. There are a number of characters which, if used in combination, should serve to separate the species of the two genera. The majority of the characters cited below should hold in all cases. Venationally these characters are as follows:

(1) The very short, usually almost transverse, radial sector of *Nephrotoma*, which in many species is transverse and simulates a cross-vein; in other species longer and more oblique, reaching its maximum length apparently in species such as *vittula* Loew.

(2) The sessile cell M_1 in *Nephrotoma*, this being rarely short-petiolate. This character has long been known, having been clearly stated by Schiner (1864). Species of *Tipula* with the cell sessile are unknown.

(3) The basal deflection of Cu_1 and the cross-vein *m-cu* at or before the fork of *M*. This character, described for the first time by

curved suture obtaining in many species (*eucera* Loew, *ferruginea* Fabricius, *pedunculata* Loew, *et al.*). The ninth tergite is usually small and rather inconspicuous, not tumid. The outer pleural appendage is fleshy, in the shape of a more or less flattened lobe, which is sometimes attenuated or arcuated.

In general, the species of *Nephrotoma* are shiny with well-marked stripes and bright colors. In some, however (as *macrocera* Say), the colors are dull, quite as in some species of *Tipula*. The six species listed before, as well as the new species described below as *Tipula pachyrhinoides*, which have hitherto been taken to be species of *Nephrotoma*, agree with the species of this latter genus only in the bright, shiny coloration, all of the other characters pointing strongly to the fact that they are really species of *Tipula*. The second *Tipula californica* described by Doane[4] thus requires renaming.

In the work by Czizek cited before,[5] the author of this excellent paper has given a critical comparison of *Nephrotoma* and *Pachyrrhina*, pointing out the fact that there is no basis at all for retaining the latter name; but in spite of this clear comparison, the two names are still kept separate. The "*discoidal cross-vein*" spoken of by the author is that portion of the vein *M* between the cross-vein *m-cu* and the fork of *M*.

Nephrotoma penumbra sp. n.

Frontal prolongation of the head with three stripes; antennæ dark brownish black, excepting the basal segment; head dull brownish; thoracic dorsum obscure dull yellow with three broad black stripes; pleura yellow spotted with brown; wings dusky; abdomen dull yellow with three stripes.

Male.—Length, 12.2-13.4 mm.; wing, 11.8-13.6 mm.

Frontal prolongation of the head moderate in length, yellow, with three broad brownish stripes, the lateral pair being more distinct than the median one. Palpi with the basal segment black, the second and third dark brown, the terminal segment light brown. Antennæ with the basal segment dull yellow, darkened toward the apex, the remaining segments dark brownish black; the flagellar segments deeply incised beneath. Front light yellow; vertex reddish brown with a linear black median vitta.

Thoracic præscutum dull obscure yellow with three broad black stripes, the median one longest and broadest; the lateral stripes not

[4] *Annals of the Entomological Society of America*, vol. 5, p. 49, 1912.

[5] Tipulidæ Moravicæ; *Zeitschrift des Mahrischen Landesmuseums*, vol. 11, pp. 49, 51, 1911.

incurved at the anterior end; scutum dull yellow, the lobes with two dark brown spots on each; scutellum dull brownish yellow; postnotum rather bright yellow with a broad median vitta, which is widest in front, narrowed behind. Pleura yellow, the mesopleurites suffused with brown on the ventral portions of the sclerites. Halteres brown. Legs with the coxæ yellowish brown; trochanters and femora light brown; tibiæ and tarsi brown. Wings strongly tinged with brown, the stigma long, brown, the veins dark brown. Venation as in Plate XVI, fig. 1.

Abdominal tergites dull brownish yellow with a very broad blackish median stripe, the lateral margins of the segments indistinctly blackened, the caudal margin very narrowly pale; eighth and ninth tergites uniformly dark brown; sternites dull yellow, the segments three to seven with a linear black median mark, broadest basally; the mark on the seventh segment short, occupying less than half the length of the segment, the other marks long, occupying about three-fourths the length of the segment; sternites eight and nine almost uniformly brownish yellow. Male hypopygium with the ninth tergite broad, having the caudal margin provided with a deep U-shaped median notch, the lateral lobes broadly rounded.

Habitat.—Northeastern United States.

Holotype, ♂, Halfway House, Mt. Washington, N. H.; July 6, 1914 (Johnson).

Paratypes, 2 ♂'s, topotypic; 3 ♂'s, Mt. Washington, N. H. (Osten Sacken).

The type is in the collection of the Boston Society of Natural History; paratypes in the collection of the Museum of Comparative Zoology and in the collection of the author.

Wings pale gray, the costal cell only a little more yellowish in color; a pale vitreous mark before the stigma, most distinct in the base of cell *1st* R_1, reappearing at the base of cell *1st* M_2; a white vitreous blotch beyond the stigma occupying the outer end of cell *2nd* R_1 and the base of R_2; stigma prominent, full, oval, dark brown; veins brown. Venation (see Plate XVI, fig. 2): *Rs* rather short, arcuated; cell *1st* M_2 elongate, narrow; a few hairs in the outer cells of the wing, in cells 1st R_1, R_2, R_3, R_5, M_1 and M_2.

Abdominal tergites light yellow, segment two with a broad cross-band at about midlength; segments two to eight with a broad apical cross-band, giving the abdomen a banded tigrine appearance; on the shortened apical segments the banding occupies almost the entire sclerite; sternites one to four pale yellow, five to eight dark brown. Hypopygium with the eighth tergite large, the caudal margin almost straight. Ninth tergite (see Plate XIX, fig. 44) large, the caudal margin with a deep U-shaped notch, the margin provided with rather numerous hairs. Ninth pleurite extensive but incomplete, the pleural suture short, curved dorsad at its tip; pleural appendages (see Plate XX, fig. 61) two, an outer fleshy lobe, moderately long, provided with numerous hairs; inner lobe more complex, consisting of a flattened blade directed dorsad, at the base on the outer edge with a sharp chitinized tooth. Ninth sternite (see Plate XVII, fig. 24) rather restricted, along the ventral median line profoundly incised. Eighth sternite extensive, the caudal margin with a deep and broad U-shaped notch.

Habitat.—Northeastern North America.

Holotype, ♂, Station Isle, Go-Home Bay, Muskoka District, Ontario, Canada, August 16, 1912 (Clemens).

ened. Legs with the coxæ dull yellow, a little suffused with brown on the anterior outer face; trochanters yellowish brown; femora dull yellow, the tip narrowly dark brown; tibiæ dull yellowish brown, soon passing into dark brown; tarsi dark brown. Wings grayish subhyaline; stigma moderately indistinct, brown. Venation (see Plate XVI, fig. 3); *Rs* long; cell M_1 petiolate; basal deflection of Cu_1 and the cross-vein *m-cu* beyond the fork of *M*.

Abdomen with the tergites brownish yellow, the caudal margin of each sclerite dark brown, sending a broad median line forward, forming a ⊥-shaped mark; on the apical segments only the median vitta persists; lateral margins of the tergites with the anterior half grayish, the caudal half dark brown; an interrupted median line on the sternites.

The paratype is quite similar to the type with the following exceptions and additions: antennal flagellum dark brownish black; the thoracic stripes very dark brownish black with the ground-color light yellow; the pattern on the abdomen is indistinct but indicated.

Habitat.—Northern United States and Canada.

Holotype, ♀, Mt. Washington, N. H.

Paratype, ♀, Farewell Creek, Southern Saskatchewan, Canada; September, 1907.

The type is in the collection of the Boston Society of Natural History; the paratype is in the collection of the author.

This small *Tipula* bears a remarkable resemblance to certain species of *Nephrotoma*, especially *N. vittula* Loew, which is likewise a northern form. The thoracic stripes in *vittula* are described as being black, but specimens in the collection of the Boston Society of Natural History have the stripes rich reddish chestnut and are

palpi light brown, the terminal segment darker. Antennæ with the four basal segments light yellow, the remainder light brown, the basal swelling of each segment only a little darker than the remainder of the segment. Front with a small tubercle; head light gray with a very narrow brown line extending from the middle of the tubercle caudad to the occiput.

Thoracic dorsum light gray with rather indistinct brown stripes, the median stripe broader in front, narrowed behind, indistinctly split by a pale middle vitta; lateral stripes narrower and less distinct; scutum pale grayish white, the middle portions of the lobes brown; postnotum and scutellum dull yellow, rather thickly dusted with grayish white. Pleura rather pale grayish white. Halteres pale, the knob brown. Legs with the coxæ pale dusted with whitish; trochanters pale yellow; femora dull yellow passing into brown toward the tip; tibiæ and tarsi brown. Wings whitish subhyaline, the costal cell more yellowish; tip of the wing broadly dark brown; an indistinct interrupted brown cross-band from the stigma along the cord; a brown cloud at the origin of *Rs*, at the arculus, at two-thirds the length of cell *M*. Venation (see Plate XVI, fig. 4): tip of R_2 atrophied.

Abdominal tergites dull yellow with a median brown longitudinal line on the first segment; remaining tergites yellowish brown, segment seven and the caudal portions of six largely dull yellow; segment nine dark brown. Sternites dull yellow, segments six to nine more brownish. Male genitalia (see Plate XVIII, fig. 32) with the eighth tergite narrow. Ninth tergite (see Plate XIX, fig. 45) subquadrate, the caudal margin deeply and broadly concave, a blunt, rounded lobe on either side of this concavity, a sharp median tooth and a smaller denticle midway between the median tooth and the rounded lobe. Ninth pleurite rather small, complete, the dorso-caudal margin produced into a sharp point which is directed caudad; the ventro-caudal portion rounded and provided with abundant rather long hairs; pleural appendages two, the outer appendage a slender, small, fleshy lobe, subsigmoid to cylindrical in shape; the inner pleural lobe is complex, consisting of a large, flattened portion which is produced in front into a moderately sharp point which is directed cephalad; underneath the base of this point on the anterior or cephalic margin is a black, chitinized lobe which is directed laterad; the base of this appendage is hollowed out into a conspicuous cup-shaped lobe which is directed laterad and bears a small, sharp spine behind and beneath.

Habitat.—Northeastern United States.

Holotype, ♂, Orono, Penobscot Co., Maine, June 14, 1913 (Alexander).

Paratype, No. 1, ♂, North Mt., Luzerne Co., Pa., June 11 (Johnson); paratype No. 2, ♂, without locality, labelled "Packard" and the label "*angulata = 258*" in Loew's writing; this is the specimen mentioned by Loew in the description of *angulata*.

The type is in the collection of the author; paratype No. 1 in the collection of Mr. Johnson; paratype No. 2 in the collection of the Museum of Comparative Zoology.

The second paratype is quite pale in color, and this may be due to the teneral condition of the fly.

The specific name is that of the Indian tribe formerly occupying a large portion of the State of Maine.

This species was taken in a small woodland at Orono, Maine. These woods are Canadian in aspect, the main floral constituents being coniferous trees, *Abies*, *Picea*, *Tsuga* and *Thuja* and the ground cover of *Coptis trifolia*, *Linnæa borealis americana*, etc. The insect occurred along a small stream flowing through rather low ground and supporting a very rich crane-fly fauna. Most of the species were swept from boughs of trees, fern growth, etc., or caught in flight or swarming. The more conspicuous species on this day were *Dicranomyia pudica*, *D. hæretica*, *D. halterata*, *D. pubipennis*, *Limnobia solitaria*, *Rhypholophus meigeni*, in small swarms, *R. rubellus*, in very large swarms, *Erioptera venusta*, *E. vespertina*, *Gonomyia subcinerea*, *Epiphragma fasciapennis*, *Limnophila rufibasis*, *L. brevifurca*, *L. fuscovaria*, *L. quadrata*, *Adelphomyia minuta*, *Rhaphidolabis* [redacted]

nent; a narrow impressed median furrow which is lined with whitish. Ninth pleurite complete, elongate oval, not in contact with the tergite; outer appendage a short, cylindrical, rather stout, fleshy lobe with rather numerous long hairs; inner appendage (see Plate XXI, fig. 76) complex, a very compressed lobe which is notched on its inner face and here heavily chitinized. Ninth sternite extensive, gently concave beneath on the caudal margin; on either side just ventrad of the pleurites with a large pale oval lobe which is densely punctulate on the outer ventral half. The penis-guard (see Plate XXI, fig. 75) is prominent, the tip a little expanded, consisting of a rounded apical lobe subtended on either side by a sharp, chitinized tooth. Eighth sternite almost straight across the caudal margin; on either side a V-shaped group of stout, conspicuous hairs, there being about 24–30 in each group.

Habitat.—Northeastern United States and Canada.

Holotype, ♂, Mt. Desert Isle, Hancock Co., Me., August 31, 1913 (Alexander).

Allotype, ♀, Fort Kent, Aroostook Co., Me., August 19, 1910 (Johnson).

Paratypes, No. 1, 2 ♂'s, Ashland Junction, Aroostook Co., Me., August 16, 1910 (Johnson); No. 3, ♂ ♀, Grand Lake, Newfoundland, July 25, 1906 (Bryant); No. 5, ♂, no locality, labelled "Packard."

Paratype No. 5 bears the manuscript name "*lævigata*" in Loew's script.

The type and paratype No. 4 in the collection of the author; the allotype and paratypes 1 to 3 in the collections of Mr. Johnson and the Boston Society of Natural History; paratype No. 5 in the Museum of Comparative Zoology.

the caudal margin on the sides; ninth tergite dark brown, the caudal margin broadly dull yellow; hypopygium reddish; sternites yellowish, on segments four to eight becoming much darker, the caudal margin broadly paler, more yellowish. Hypopygium (see Plate XVIII, fig. 33) with the ninth tergite (see Plate XIX, fig. 47) thickened, tumid, with a very deep shield-shaped notch continuing back almost one-half the length of the sclerite, the lateral lobes rather pointed; a prominent point on the middle line beneath, this directed caudad. Ninth pleurite (see Plate XX, fig. 62) rather extensive, nearly complete, the caudal margin produced caudad into a prominent lobe; a subtriangular fleshy lobe (*a*) from the caudal margin of the pleurite beneath, this lobe densely covered with prominent setiferous papillæ directed caudad and laterad; pleural appendages consisting of an outer, rather larger, cylindrical, pale fleshy lobe which is provided with numerous long hairs; inner appendage complex, consisting of a broad, pale, flattened and very compressed lobe, suboval, with the cephalic outer margin produced outward as a black, more chitinized bar which is connected with the main lobe only at its base. Ninth sternite deeply divided by a profound cut in which hang two pendulous lobes from the ventral inner portions of the ninth pleurite, these lobes with numerous long hairs at the tip only. Eighth sternite almost straight across the caudal margin. Penis-guard very complex, ventrally near the tip with two sharp straight points on each side; anal tube prominent, pale.

Female.—Frontal prolongation of the head rather short, brown; palpi short, dark brown. Antennæ short, the two basal segments rich brown, flagellum dark brown, unicolorous. Head rich brown, an indistinct dark brown median vitta

clusive that the condition can be stated definitely at this time. The males (*speciosa*) are very light colored, yellowish; the females (*fuliginosa*) are dark brownish to almost black. This is the first case of dimorphism in the Tipulidæ that has come to my notice, but the related species, *jejuna* Johnson and *taughannock* sp. n., certainly belong here.

This evidence of dimorphism in the species that is before me is as follows: a male and a female, taken in copulation, collected at Ira, Summit Co., Ohio, by James S. Hine. A male and a female secured in copulation and actually pinned while still "in coitu," collected at light, Boston, Mass., June 1, 1914, by H. M. Parshley. The final evidence is the finding of two crane-fly pupæ in the débris beneath the nest of a turkey vulture, on Jacksons Island, Md., May 23, 1913, by Messrs. Barber and Shannon. The material was taken to the laboratory, and both specimens emerged on May 23, 1913, one a male *speciosa*, the other a female *fuliginosa!*

On June 13, 1914, on Buell Mt., Fulton Co., N. Y., the males of this fly were common on the mountain side in the open shady woods. One female was taken. The males were usually found flying up a tree-trunk, beginning low down near the base of the tree, ascending by a partly flying, partly climbing motion. They were undoubtedly searching for the retiring females, as has been observed in other woodland-inhabiting species, as *fragilis* and others.

Tipula hermannia n. n.

Tipula fasciata Loew; Berliner Entomologische Zeitschrift, vol. 7, p. 279, 1863 (non *Tipula fasciata* Linnæus, 1767).

The Loewian name, *fasciata*, is a primary homonym of that of Linnæus, and the species is herewith changed as above. The insect

nasus very long and slender, reddish brown. Palpi dark brown. Antennæ rather elongated in the male, the scape yellowish brown, segments three to five with the base of a paler brownish yellow than the remainder of the segment, the terminal flagellar segments uniformly brown; segments of the flagellum with a short basal enlargement which is about one-third of the length of the segment. Head light gray.

Pronotum pale brown, the scutellum deeply divided medially by an impressed black line which ends on the caudal margin of the scutum. Mesonotal præscutum brownish gray without distinct stripes excepting the single very narrow median vitta which runs to the suture; scutum with the lobes dark gray, the median area paler, brown; scutellum pale yellowish white with a sparse light gray bloom; postnotum light gray with a delicate impressed median line on the caudal half. Pleura clear light gray. Halteres brown. Legs not elongated as in the closely allied *perlongipes* Johnson, with the coxæ pale brown with a sparse grayish bloom; trochanters and femora yellow, the latter narrowly dark brown at the apex; tibiæ light brown, the terminal portion dark brown; tarsi yellowish brown. Wings light brown, the costal region more yellowish; the stigma pale brown; a vitreous band before the cord extending into cell *1st* M_2; vein *Cu* and its branches indistinctly seamed with brownish. Venation: *Rs* long; cross-vein *m-cu* at the fork of *M*, very long and prominent (see Plate XVI, fig. 6).

Abdomen with the first tergite grayish, the remainder dark brown; segments three to five with the caudal margin conspicuously pale silvery; tergite three with a broad basal band destitute of hairs and including a transverse rectangular area that is provided with large, coarse punctures; this does not occur on the succeeding tergites; sternites brown, the lateral margins and the apices a little more yellowish. Hypopygium (see Plate XVIII, fig. 34) as in *perlongipes* Johnson, *sulphurea* Doane, *et al.*, the ninth tergite practically fused with the sterno-pleural region into a continuous ring; there is a very indistinct groove between the tergite and sternopleurite; region of the ninth tergite (see Plate XIX, fig. 48) small, the caudal margin straight across or nearly so with a very broad median lobe which is weakly divided by a U-shaped median notch; viewed from the side, this median lobe is high and prominent, the caudal end blackened, spiculose. Ninth sterno-pleurite extensive, the pleural suture indicated beneath, the pleural region cylindrical, produced caudad; outer pleural appendage a flattened, subrectan-

gular lobe with a small lobule on the ventral outer edge, this appendage pale and covered with a dense, pale pubescence; the inner appendage is also pale and fleshy, arising from the apex of the pleural region just inside the outer pleural appendage; this appendage is darker colored, thicker, reddish yellow; from the notch between the pleurite and the sternite arises a flattened, chitinized appendage. Ninth sternite divided to the very base by a split which widens out behind. Eighth sternite unarmed.

Habitat.—Arctic America.

Holotype, ♂, Fort Resolution, Hudsons Bay Territory, Canada (Kennicott).

The type is in the collection of the Museum of Comparative Zoology where it bore the manuscript name of *tetra* in Loew's writing. This species is dedicated to the intrepid Arctic explorer and collector, Robert Kennicott.

This species can be confused only with the more southern *perlongipes* Johnson, from which it may be separated by the following key:

1. Antennæ bicolorous; thorax pale yellow with three brown stripes, the lateral pair less distinct than the median one; legs long (male, fore leg, femur, 10 mm.; tibia, 11.8 mm.; middle leg, femur, 11.3 mm.; tibia, 11.5 mm.); male hypopygium with the median lobe of the ninth tergite entire or the bifid nature barely indicated; outer pleural appendage long and narrow, narrowed at both ends; ninth sternite extensive, deeply incised, the margins of the incision closely appressed forming a carinate ridge (Eastern United States)........................*perlongipes* Johnson.[6]

Antennæ unicolorous or nearly so; thorax gray with a single delicate brown line; legs short (male, fore leg, femur 7.3 mm.; tibia, 9 mm.; middle leg, femur, 8.5 mm.; tibia, 8.8 mm.);

narrow; eighth tergite with the margins flattened, conspicuously expanded; tergal valves of the ovipositor long, pale (Hudsons Bay Territory)..*piliceps* sp. n.

Color of the thorax blue-gray with the stripes almost black, broad, and the median pair tending to become confluent; median vitta of the head distinct; dorsal abdominal vitta broader, more diffused; eighth tergite with the margins not conspicuously expanded; tergal valves of the ovipositor smaller (Northern Greenland; Polaris Bay)..............*besselsi* O. S.[7]

Tipula imperfecta sp. n.

Coloration grayish brown, the thoracic stripes indistinct; cell *1st* M_2 open by the atrophy of the medial cross-vein.

Female.—Length about 11 mm.; wing, 10.5 mm.

Frontal prolongation of the head rather short, yellowish brown. Palpi brown. Antennæ with the basal segments dull yellow, the flagellum dark brown; antennæ rather long for this sex. Head dull gray with a narrow dark brown median vitta.

Pronotum dark grayish brown, the scutellum more yellow on the sides. Mesonotal præscutum dark grayish brown, the stripes in the type specimens indistinct; scutellum a little paler. Pleura with the mesopleuræ rather clear gray, the posterior pleurites dull light yellow. Halteres dull in color, the knobs darker brown. Legs with the coxæ dull yellow, suffused basally with grayish brown; trochanters brownish yellow; femora dull yellow, broadly dark brown at the apex; tibiæ similar, narrowly dark brown at the apex; tarsi brown. Wings light gray, the stigma yellowish brown; an indistinct vitreous band before the stigma. Venation (see Plate XVI, fig. 9).

Abdominal tergites dull brownish yellow, the caudal margins of the

Holotype, ♀, Labrador (Packard).

Paratype, ♀, topotypic.

The types are in the collection of the Museum of Comparative Zoology. The specimens bear the number 395 and the manuscript name as given to the species, the label in Loew's writing.

The character of the open cell *1st M_2* is almost unknown in this genus, but since both specimens show the character in both wings it seems that the manuscript name suggested by Loew is a good one. The *Tipula alta* Doane (*Annals of the Entomological Society of America*, V, 44, 1912) also shows this venational character.

Tipula cayuga sp. n.

Coloration gray or grayish brown, abdomen yellow; bases of the antennal flagellar segments dark brown, the segments constricted; male hypopygium with the ninth tergite having the caudal margin with a bifid median lobe.

Male.—Length, 15–18 mm.; wing, 16.8–18.5 mm.; fore leg, femora, 9.8 mm.; tibiæ, 11.8 mm.; middle leg, femora, 11.2 mm.; tibiæ, 10.8 mm.

Female.—Length, 24 mm.; wing, 21 mm.

Frontal prolongation of the head rather long, above grayish to almost white, passing into yellowish beneath; palpi brown. Antennæ rather short, scape and first flagellar segment light yellow; remaining segments of the flagellum dark brownish black at the base, the remainder of each segment being yellowish; the apical segments are more uniformly brown; the flagellar segments are deeply incised, the two ends being noticeably enlarged. Head with the front whitish, the vertex light gray, behind the eyes more suffused with brown.

Thoracic pronotum dull yellow. Mesonotal præscutum light gray or grayish brown with three distinct thoracic stripes, these stripes pale brownish yellow, distinctly and sharply margined with darker brown; scutum light gray, the anterior part of each lobe dark brown; scutellum and postnotum dull yellow, whitish pollinose. Pleura yellowish, thickly white pollinose. Halteres pale yellow at the base, brown at the tip. Legs with the coxæ yellow, densely white pollinose; femora yellow, a little darkened at the tip; tibiæ light brown soon passing into the dark brown of the remainder of the legs. Wings pale yellowish subhyaline to hyaline, the costal cell yellowish; a brown stigmal spot, more yellowish in front; a large vitreous spot before and behind the stigma; veins dark brown. Venation as in Plate XVI, fig. 10.

Abdomen yellow, the tergites two to eight with the caudal margin

blackish or grayish, black subterminally, the lateral margins broadly paler. Hypopygium with the ninth tergite (see Plate XIX, fig. 49) yellow caudally, black basally, with the caudal margin produced into two long lobes with the tips blackened, minutely spiculose. Ninth pleurite very extensive though incomplete, the pleural suture being indicated beneath, curved dorsad at the end; the ventral inner angle of the pleurite is densely clothed with long hairs; two pleural appendages (see Plate XX, fig. 63) the outer appendage flattened, broad, pale, the tip obtusely rounded; the inner appendage is complex, more chitinized, with a ventral arm (*v*) directed caudad and ventrad, its tip with a few scattered irregular teeth; the dorsal arm (*d*) deeply concave beneath. Guard of the penis long, slender, prominent.

Habitat.—Northeastern United States.

Holotype, ♂, Simmons Woods, Fulton Co., N. Y., June 9, 1914 (Alexander).

Allotype, ♀, Orono, Penobscot Co., Me., June 14, 1913 (Alexander).

Paratypes, No. 1, 3 ♂'s, topotypic; No. 4, "The Glen," Ithaca, Tompkins Co., N. Y., May 30, 1911 (Alexander); No. 5, 2 ♂'s, Orono, Penobscot Co., Me., June 14, 1913 (Alexander); No. 7, ♀, Ithaca, Tompkins Co., N. Y., reared, May 13, 1914; No. 8, 2 ♂'s, Indian Castle, Herkimer Co., N. Y., June 13, 1915 (Alexander).

The types are in the collection of the author.

The specific name is that of the Indian tribe, one of the Five Nations.

The type specimen was taken in Simmon's woods, Gloversville, N. Y., on June 9, 1914. It occurred along a small woodland stream supporting a rich vegetation with decided Canadian tendencies, the principal species being *Osmunda regalis*, *O. cinnamomea*, *O. Clay-*

The insect was common on June 5, 1913, in a woody tract along the Stillwater Bayou, Orono, Me., where it occurred with *Dicranomyia liberta*, *Erioptera caloptera*, *E. armata*, and *Tipula bella*.

The fly was reared from a large aquatic larva found in the Indian Spring near Ithaca, Cayuga Lake, N. Y., where it occurred in the beds of water-cress (*Radicula nasturtium-aquaticum*) in company of other Tipulid larvæ, such as *Pedicia albovitta*, *Limnophila quadrata*, *Tipula abdominalis* and *T. bella*, as well as a host of the usual aquatic organisms. Other larvæ of this species, likewise strictly aquatic, were found in Coy Glen, Ithaca, N. Y., a rapid-flowing gorge stream.

Tipula triton sp. n.

Coloration light yellow; antennæ bicolorous; thoracic stripes reddish brown; abdomen with a series of about four conspicuous rounded brown spots along the sides; male hypopygium with the ninth tergite trifid; penis-guard subtended by two very large blade-like appendages which are drawn out apically into sharp points.

Male.—Length, 13.2–13.5 mm.; wing, 13.5–13.6 mm.

Frontal prolongation of the head rather long and slender, brownish yellow, the nasus distinct; palpi short, brown. Antennæ moderately long, the three basal segments dull yellow, the remaining segments of the flagellum with a distinct dark brown basal enlargement, the apex of the segments brownish yellow, on the terminal three or four segments more brownish. Head pale yellowish gray with an indistinct brownish subimpressed median line.

Thoracic dorsum light yellow with three indistinct light reddish brown stripes of which the median one is bisected by a narrow median ground vitta; the lateral præscutal stripes begin immediately behind the prominent pseudosutural foveæ; scutum dull light yellow, each lobe with two reddish brown spots which are approximated; scutellum and postnotum dull light yellow. Pleura yellowish, heavily whitish pollinose. Halteres rather short, the stem yellowish, the knob brown. Legs with the coxæ yellowish, whitish pollinose; trochanters yellow; femora yellow, the apex narrowly brown; tibiæ yellowish brown, the apex narrowly and very indistinctly darker; tarsi dark brown. Wings subhyaline with a faint brownish tinge, the costal cell more yellowish; the stigma large, light brown, indistinct; a narrow vitreous band before the stigma extending along the cord into cell *1st* M_2. Venation as in Plate XVI, fig. 11.

Abdominal tergites brownish yellow, the segments six and seven dark brown; eight yellowish, the ninth reddish; the apices of the segments are very narrowly ringed with silvery; on segments three

to six a conspicuous rounded brown spot on the sides of the segment near the base; sternites one to five yellow more or less suffused with brown, the terminal sclerites yellowish. Male hypopygium with the ninth tergite (see Plate XIX, fig. 50) rather prominent, flattened, the caudal margin with a broad and deep U-shaped notch and trifid, consisting of the flattened subacute lateral lobes and an acute median point; an indistinct median dorsal furrow. Ninth pleurite prominent, complete, rounded oval. The outer pleural appendage (see Plate XX, fig. 65) is situated near the end of the sclerite, strongly arcuated in the form of a boomerang, pale, covered with setigerous papillæ, the apex ending in a conical pale horny point. The inner pleural appendage (see Plate XX, fig. 66) is more chitinized, the apex heavily chitinized and blackened, deeply split into two lobes; around the notch on the inner face of the appendage is a group of about twelve prominent setigerous tubercles; a group of about four similar tubercles down the inner side of the appendage; outer face of this organ with several prominent subparallel ribs. The penis-guard viewed from the side (see Plate XXI, fig. 79) deeply bilobed by an oval-rounded notch; the ventral margin is produced into the gonapophyses which are much longer than the penis-guard which they subtend (see Plate XXI, fig. 78); these latter are flattened and blade-like, the apex produced into a point. Ninth sternite scarcely if at all notched medially beneath, the caudo-lateral angle beneath the pleurite with a broadly rounded lobe which is densely covered with tubercles bearing long yellowish hair, these tending to be contorted at their apices. Eighth sternite not projecting, the caudal margin straight or nearly so, bearing a tuft of long yellow hairs on either side, including two long, powerful, chitinized, decussate bristles.

[redacted]

Male.—Length, 15 mm.; wing, 16.3 mm.

Frontal prolongation of the head long, pale brownish yellow, with a sparse whitish bloom. Palpi almost black. Antennæ with the three basal segments dull yellow, the remainder of the flagellum uniformly dark brownish. Head light gray with a subimpressed dark brown median vitta.

Pronotum pale, a little darkened on either side of the middle line. Mesonotal præscutum dull gray with darker brown vittæ, the median stripe divided into two by a very broad line of the ground color; lateral stripes indistinct; scutellum and postnotum much clearer gray. Pleura with the mesopleura clear light gray, the dorsal membrane and the metapleura dull yellow. Halteres yellow, passing into dark brown on the knob. Legs with the coxæ and trochanters dull light yellow, the former sparsely whitish pollinose; femora yellow, darkened at the apex; tibiæ and metatarsus yellowish brown, the segments a little darkened at the apex; remainder of the tarsi brown. Wings as in Plate XVI, fig. 12.

Abdomen with the sides of the first two tergites bright yellowish, the dorso-median line and the remaining tergites brown; segments with a broad lateral and a narrow caudal pale margin; hypopygium reddish; sternites brown, more yellowish laterally; segments three to five with a conspicuous caudal margin of the same color. Male hypopygium with the ninth tergite (see Plate XIX, fig. 51) rather small, subquadrate, narrowed apically, the caudal margin with a broad V-shaped notch whose edge is provided with a few chitinized tubercles; a shallow dorsal median groove. Ninth pleurite incomplete, indicated beneath, situated high up on the caudal face of the ninth sternite so that its inner dorsal angle about touches the ninth tergite; the caudal end of the pleurite is produced caudad into a flattened, subspatulate lobe (see Plate XX, fig. 67), in this suggesting the condition found in *T. macrolabis*, though to a very much lesser degree; a few scattered black hairs at the base of the sclerite on the outer side, outer pleural appendage a subcylindrical fleshy lobe with numerous long pale hairs; inner pleural appendage a flattened lobe which lies across the genital chamber, this bearing a sharp spine behind directed outward and a rounded concave lobe directed dorsad, the two being portions of a high dorsal crest of the appendage; cephalic arm of the appendage hidden beneath the ninth tergite. Ninth sternite with a deep V-shaped notch beneath, the ventromedian area pale, submembranaceous; at the lateral end of this notch and just below the pleurite is a papillose lobe directed inward

and bearing a dense tuft of long pale hairs at the apex, these tufts hanging penduously in the notch of the sternite. Eighth sternite extensive, narrowed posteriorly, the caudal margin broadly U-shaped and bearing a long row of prominent yellow hairs on the edge.

Habitat.—Arctic America.

Holotype, ♂, Fort Resolution, Hudsons Bay Territory (Kennicott); in copulation with the allotype.

Allotype, ♀, topotypic.

Paratypes, 3 ♂'s, ♀, topotypic.

The type material is in the collection of the Museum of Comparative Zoology; paratypes in the collection of the author. The specimens bear the label No. 137 and the chirotypic name "*simplex*" in Loew's writing.

The species is dedicated to Dr. Hermann Loew.

Tipula mingwe sp. n.

Allied to *cincticornis;* color brownish yellow; size large; wings yellowish subhyaline with the vitreous lunate mark extending across the cell *1st* M_2 into cell M_4; male genitalia with the ninth tergite having the lateral lobes truncated, not pointed; ninth pleurite complete.

Male.—Length, 16 mm.; wing, 18 mm. Fore leg, femora, 9.2 mm. Hind leg, femora, 11.3 mm.; tibiæ, 13.8 mm.

Female.—Length, 20 mm.; wing, 16.2 mm.

Frontal prolongation of the head rather long, yellowish brown; palpi elongate, brown. Antennæ rather short, the first three segments yellowish brown, the remaining segments with about the basal quarter enlarged, dark brown, remainder of the segments medium brown, becoming darker on the terminal segments. Head light brown, rather broadly margined with yellowish along the posterior border of the eye.

cell M_4, sometimes indistinct and difficult to detect; veins dark brown. Venation (see Plate XVI, fig. 13): R_2 beyond cross-vein *r* long, persistent, much longer than R_{2+3}; basal deflection of R_{4+5} nearly obliterated so that the radial sector is in a line with R_{4+5}.

Abdominal tergites with a dark brownish black, interrupted, dorso-median line; a much less distinct pale brown lateral stripe; ninth segment darker, brownish black; the caudal margin of the segments very indistinctly grayish; sternites pale brown. Male genitalia with the ninth tergite large, subquadrate, the caudal margin with a deep U-shaped notch, the lateral lobes subtruncate, not at all pointed. Ninth pleurite large, complete, with three appendages (see Plate XX, fig. 68) the outermost and most caudad is a flattened lobe which is narrowed into a sharp, curved point at the tip, the outer face of the blade of this appendage is densely provided with long, delicate, pale hairs; the next appendage consists of a broad foliaceous blade whose inner margin near the tip is prolonged into a short, black, heavily chitinized lobe and whose main portion is produced entad and cephalad into a conical lobe; the third appendage, which lies the furthest cephalad but is almost as far laterad in position as the first appendage, is a slender fleshy lobe which is densely provided with long, coarse, black hairs. Ninth sternite deeply and profoundly split medially, at its caudal angle bearing a short, fleshy pendulous appendage as in this and related groups of species in this genus. Eighth sternite with the caudal margin broadly concave, this concavity with about a dozen long hairs, the sides of the concavity with a bunch of about five long reddish hairs.

The female has the antennæ indistinctly bicolored, the bases of the individual segments only slightly darkened; in some specimens the thoracic stripes are quite indistinct; ovipositor with the upper valves broad at the base, rapidly tapering to the subacute slender point; lower valves shorter, compressed-flattened, blade-like, acute at the tip.

Habitat.—Northeastern United States.

Holotype, ♂, Bennett Lake, Hope Township, Hamilton Co., N. Y., altitude 1,500 feet, September 12, 1912 (Alexander).

Allotype, ♀, topotypic.

Paratypes, No. 1, ♂, Delaware Water Gap, Warren Co., N. J., July 9 (Johnson); No. 2, 2 ♂'s, Manlius, Onondaga Co., N. Y., August 20 (Comstock); No. 4, 2 ♂'s, topotypic; No. 6, 5 ♂ ♀, Plummer's Island, Maryland, July 21, 1915 (McAtee and Alexander); No. 11,

6 ♂ ♀, Scott's and Difficult Runs, Fairfax Co., Va., July 25, 1915 (McAtee and Alexander).

The specific name is that of the Delaware name for the Iroquois.

The type, allotype and paratypes Nos. 4, 5, 9, 10, 15 and 16 are in the collection of the author; paratype No. 1 in the collection of Mr. Johnson; paratypes Nos. 2 and 3 in the Museum of Comparative Zoology; the remaining paratypes in the United States Biological Survey collection.

There is a possibility that this may be *Tipula cincticornis* Doane, but the description of the latter implies that the outer lobes of the ninth tergite are acute as in *Tipula submaculata* Loew. Under these circumstances, the present insect must be considered to be distinct.

Tipula monticola sp. n.

Coloration yellowish; antennæ bicolorous; head light gray; thoracic stripes quite indistinct, brownish orange; wings hyaline, the costal region yellowish; male genitalia with the ninth tergite large, the caudal margin deeply U-shaped, bearing a small lobe underneath, the lateral lobes of the tergite broad, the tip a slender, chitinized point; inner pleural appendage with the caudal arm pointed, the inner arm blade-like, draped on its outer face with a delicate ribbed membrane; eighth sternite with two great tufts of long silvery hairs.

Male.—Length, 17–18 mm.; wing, 18–19 mm.

Frontal prolongation of the head long, rather slender, dull yellow, a little gray above; palpi brown. Antennæ rather short, the three basal segments yellow, the remainder of the organ with the swollen [redacted]

nearly so, the costal region light yellow, the stigma a little darker brown; a broad vitreous band before the stigma, along the cord and into cell *1st* M_2; a vitreous blotch beyond the stigma occupying most of cell *2nd* R_1. Venation as in Plate XVI, fig. 14.

Abdomen dull yellow without distinct stripes, the caudal margin of the tergites three to eight broadly margined with silvery; hypopygium reddish. Male genitalia with the eighth tergite rather broad, the margin being straight; ninth tergite (see Plate XIX, fig. 52) large, the caudal margin with a deep U-shaped notch which bears a small rounded median lobe beneath; the dorsal surface bears a broad median groove or depression to the base; the lateral lobes are broad, directed caudad, the tip a cylindrical chitinized point which is directed ventrad and slightly inward. Ninth pleurite (see Plate XVIII, fig. 35) large, prominent, oval, convex, not in contact with the ninth tergite; appendages two: outer appendage a long, cylindrical, fleshy lobe, subsigmoid, pale, covered with long divergent hairs; inner appendage complex (see Plate XX, fig. 69), composed of a caudal lobe which is directed backward, pointed, and a cephalic lobe which is compressed, black and heavily chitinized along the margin; on the outer face of this blade is a conspicuous membrane which is provided with numerous hair-like ribs. Ninth sternite extensive, convex, very deeply notched beneath and with a pair of very short fleshy lobes which bear dense tufts of long yellow hairs, each decussate with the tuft of the opposite side. Eighth sternite (see Plate XVII, fig. 26) large, prominent, projecting caudad, the posterior margin with a rounded notch which bears a dense tuft of long silvery white hairs on each side of the middle line.

Habitat.—Eastern United States.

Holotype, ♂, Woodworths Lake, Fulton Co., N. Y., altitude 1,600 feet, June 18, 1914 (Alexander).

Paratypes, No. 1, ♂, North Mt., Luzerne Co., Pa., June 8 (Johnson); No. 2, ♂, topotypic; No. 3, 3 ♂'s, Sacandaga Park, Fulton Co., N. Y., June 11, 1914 (Alexander); No. 6, 2 ♂'s, Indian Castle, Herkimer Co., N. Y., June 13, 1915 (Alexander).

The type and paratypes 2 to 7 in the collection of the author; paratype No. 1 in the collection of Mr. Johnson.

Tipula tuscarora sp. n.

Coloration yellowish; antennæ bicolorous; wings yellowish; thoracic stripes very indistinct; male genitalia with the ninth tergite very large, deeply notched, the lateral lobes produced into long, slightly curved horns; the outer pleural lobe is produced into

a very conspicuous curved hook; eighth sternite with two strong decurved bristles on the caudal margin.

Male.—Length, 16 mm.; wing, 17.2 mm.

Frontal prolongation of the head rather elongate, shining, dull yellow; palpi dull yellow, the two terminal segments brown. Antennæ short, the three basal segments yellow, remainder of the organ with the basal swelling of each segment brownish black, the remainder yellow, the two terminal segments a little darker. Head brownish yellow, an indistinct brown median line extending the length of the head.

Thoracic dorsum dull light yellow, unstriped or nearly so, the usual interspaces on the præscutum being a little more grayish only. Pleura yellow, sparsely whitish pollinose. Halteres rather long, slender, pale, the knobs darker. Legs with the coxæ and trochanters dull yellow, the remainder broken. Wings grayish yellow, the costal region and the stigma brighter yellow; an interrupted vitreous band before the stigma, broadest in cell *1st* R_1 before the stigma and in cell *1st* M_2, narrowly connecting the two along the cord; a small, indistinct, vitreous spot beyond the stigma. Venation as in Plate XVI, fig. 15.

Abdomen dull brownish yellow. Male genitalia (see Plate XVIII, fig. 36) with the eighth tergite prominent, its caudal margin straight across. Ninth tergite (see Plate XIX, fig. 53) very long, subquadrate, the caudal margin with a deep acute notch, the lateral lobes produced into long, somewhat curved horns which are directed slightly inward, the extreme tip ventrad. Ninth pleurite (see Plate XX, fig. 64) complete, rather small, the dorsal end sharply angular and barely attaining the ninth tergite; appendages two: a short,

Habitat.—Eastern United States.

Holotype, ♂, Glencarlyn, Fairfax Co., Va., June 21 (Knab).

Paratype, ♂, District of Columbia (Osten Sacken).

The type is in the collection of the United States National Museum, the paratype in the Museum of Comparative Zoology. The latter specimen is part of the Loew collection and bears the manuscript name "*hamata*" in Loew's writing; to the specimen Osten Sacken has added the following label: "Notice the small forceps below the large one."

The specific name adopted is that of the Indian tribe of the same title.

Tipula seminole sp. n.

Coloration yellowish, antennæ rather indistinctly bicolorous; thorax brownish yellow without distinct stripes in alcohol; wings pale yellow or brownish yellow, the costal area and the stigma darker. Male genitalia with the ninth tergite square, with a deep rectangular notch, the lateral lobes rounded.

Male.—Length, 12.5 mm.; wing, 12.6 mm.; antennæ about 4.6 mm.

Female.—Length, 23.5 mm.; wing, 15.8 mm.

Frontal prolongation of the head rather long, moderately slender, dull yellow, the palpi brownish yellow. Antennæ rather short, the first three segments yellow or yellowish, remainder of the antennæ with the basal enlargement dark brown, the remainder of each segment brownish yellow, this color darker on the terminal segments so that the color at this point is more unicolorous.

Thoracic dorsum brownish yellow without distinct stripes (in alcohol). Pleura dull yellow, indistinctly marked with brown. Halteres rather pale throughout. Legs with the coxæ and trochanters dull yellow, the femora similar, a little darkened at the tip; tibiæ and tarsi yellowish brown. Wings pale yellow or brownish yellow, the costal cell and the stigma more saturated, the latter rather indistinct; a vitreous mark before the stigma extending into cell *1st* M_2; veins brown. Venation as in Plate XVI, fig. 16.

Abdomen light yellow with a brown subbasal spot on the sides of the tergites, most distinct on segments two to five. Hypopygium of the male (see Plate XVIII, fig. 37) having the ninth tergite (see Plate XIX, fig. 54) square or nearly so, with a deep rectangular median notch on the caudal margin, the adjacent lobes obtusely rounded. Ninth sternite in contact with the ninth tergite, the pleurite complete or nearly so, the pleural suture being better indi-

cated beneath, shaped as a straight ventral line turned dorsad at its cephalic end almost at right angles to the ventral base line. Pleural appendages two, the outer appendage a short, rather stout, cylindrical lobe, pale and fleshy, which is provided with rather numerous hairs; inner pleural appendage, a flattened blade with the cephalic face notched and here with a shortened, finger-like lobe; the tip of this blade is quite pointed, chitinized; a triangular lobe from the ventro-caudal face of the pleura, this with numerous delicate pale hairs and a few short, stout ones. Ninth sternite with a shallow notch caudally, but not deeply incised. Eighth sternite (see Plate XVII, fig. 28) almost straight across the caudal margin with a small protuberance on either side of the middle line; a fringe of long hairs across the caudal margin, one or two on the outer side of the protuberance much stouter and curved. Penis-guard and the apophyses shaped as in Plate XXI, fig. 77.

Habitat.—Southeastern United States.

Holotype, ♂, St. Simons Island, Glynn Co., Ga., April, May, 1911 (J. Chester Bradley, coll.).

Allotype, ♀, topotypic.

Paratypes, 4 ♂'s, topotypic.

The types are in the Cornell University collection, paratypes in the collection of the author.

The specific name is that of the native Indian tribe formerly occupying Florida and the adjoining regions.

Tipula penicillata sp. n.

Coloration grayish; thoracic stripes distinct; wings light brown, the tip darker, a large vitreous spot before and beyond the stigma; male hypopygium enlarged, with a dense pencil of stiff yellow hairs [redacted]

narrowly split by a pale middle vitta, lateral stripes quite indistinct; scutum yellowish brown with the lobes darker, grayish; scutellum yellowish brown; postnotum light gray. Pleura clear light gray, with the membranaceous area yellowish. Halteres rather short, brown, the knobs dark brown with the apex more yellowish. Legs with the coxæ brown with a sparse grayish bloom; trochanters dull yellow; femora brownish yellow, narrowly tipped with dark brown; tibiæ and tarsi brown. Wings light grayish brown, the costal region scarcely darker, the wing-apex darkened; stigma dark brown; a broad vitreous antestigmal band and a large vitreous spot beyond the stigma in the apex of cell second R_1 and base of cell R_2.

Abdominal tergites one and two yellowish, the remaining tergites dark brown with a narrow dark brown median vitta; a narrow caudal margin of yellowish silver; sternites yellow with a broad median triangle on segments five to seven with the apex of the triangle at the caudal margin; segments eight and nine brownish yellow; hypopygium enlarged. Male hypopygium with the ninth tergite large, prominent, the dorsal surface flat or a little convex; the caudal margin with a very deep V-shaped notch, the lateral lobes a little produced on the outer side. Ninth sterno-pleurite somewhat restricted, the pleural suture not well indicated, the pleurite lying on the dorso-caudal face of the sternite; outer pleural appendage a very slender filiform lobe, fleshy, pale, with long hairs; inner pleural appendage complex, the caudal lobe produced into a slender curved hook which is bent upward; the inner lobe is flattened, the anterior margin blackened and heavily chitinized, deeply notched; the blade with a protecting mantle of delicate fine ribules (as in *monticola*). Ninth sternite darker colored than the pleurite and provided with a few scattered hairs, deeply notched medially; a stout pendulous lobe which bears a dense tuft or pencil of long reddish hairs, this pencil directed ventrad. Eighth sternite large, prominent, extending far caudad and its concavity forming a sheath for the base of the ninth sternite; the lateral angles bear dense tufts of long, stout, reddish-silvery hairs which are decussate; between these lobes a broad median projection whose lateral angles are slightly recurved and whose caudal margin is broadly concave: this latter lobe is hidden by the prominent tufts of hair.

Habitat.—Arctic America.

Holotype, ♂, Hudsons Bay Territory, Canada (Kennicott).

The type is in the collection of the Museum of Comparative Zoology, where the specimen bore in Loew's writing the name adopted herein.

Tipula rangiferina sp. n.

Coloration yellowish brown; antennal flagellum unicolorous; thorax without distinct stripes; lateral margin of the abdominal tergites with five brown spots; male genitalia with the ninth tergite broadly concave behind, the lateral angles produced into prominent blunt horns which suggest the budding horns of a stag.

Male.—Length, 13 mm.; wing, 13.5 mm.

Female.—Length, 16 mm.; wing, 14.7 mm.

Frontal prolongation of the head moderate in length, light brown. the nasus prominent; palpi light brown. Antennæ with the three basal segments dull brownish yellow, the remainder of the flagellum almost black, each segment with a basal swelling, the segments with a whitish pubescence. Head dark gray.

Pronotum and the dorsum of the mesonotum light brown, without distinct darker markings. Pleura pale brownish yellow. Halteres long, rather slender, the stem pale, the knob brown. Legs with the coxæ yellowish; the trochanters brownish yellow; femora yellowish brown, the tip dark brown; tibiæ brownish yellow, the tip narrowly dark brown; tarsi brown. Wings light grayish; stigma distinct, light brown; a broad vitreous band before the stigma extending into cell M_4; a very small vitreous spot beyond the stigma in the base of cell R_3; veins brown. Venation as in Plate XVII, fig. 17.

Abdominal tergites brownish yellow, a little darker dorsally, each segment with the caudal margin silvery; tergite two with a large rounded spot on the side at about midlength; tergites three to six with this spot basal, conspicuous; apical tergites brownish, the hypopygium more reddish; sternites dull brownish yellow; the sclerites are provided with numerous scattered black hairs. Male [redacted]

and covered with a dense whitish pubescence. Head light gray with a distinct dark brown median vitta.

Mesonotal præscutum dull brownish gray, the middle vitta broadly divided by a dull gray median stripe which is much broader than the brown margin enclosing it; lateral stripes rarely distinct; scutum dull brownish gray, the lobes a little more brownish medially; scutellum and postnotum yellowish gray with a narrow dark brown median stripe. Pleura light gray, the dorsal pleurites more yellowish. Halteres rather elongate, the stem somewhat pale, the knobs large, dark brown. Legs with the coxæ dull light yellow covered with a sparse white pollen; trochanters dull yellow; femora dull yellowish brown, the apices indistinctly darker brown; tibiæ brown, darkened at the apex; tarsi brown. Wings light gray; stigma distinct, dark brown; a pale vitreous band before the stigma, interrupted in the vicinity of cross-vein *r-m*; a vitreous spot beyond the stigma in cell *2nd* R_1. Venation as in Plate XVII, fig. 18.

Abdomen dull yellow, quite bright in places; a dorsal brown stripe which is almost continuous, interrupted only by a narrow silvery caudal margin to the individual segments; on the seventh to ninth segments this band is in some specimens more broadened out to cover the segment or nearly so; an interrupted brown stripe on the sides of the tergites, this consisting of a large brown blotch about midlength of each segment, on the seventh segment often becoming confluent with the dorsal stripe; sternites dull yellow. Male genitalia (see Plate XVIII, fig. 39) with the ninth tergite (see Plate XIX, fig. 56) small, subquadrate, much broader than long, the caudal margin with a deep V-shaped notch whose edge is chitinized and microscopically denticulate. Ninth pleurite incomplete, the pleural

stripes; male hypopygium with the ninth tergite deeply notched medially; eighth sternite not armed with hair-bearing lobes.

Male.—Length, 14.2 mm.; wing, 17.2 mm.

Frontal prolongation of the head moderately long, pale brownish white above, brown on the sides, the nasus distinct. Palpi rather short, dark brown. Antennæ with the scapal segments dull brownish yellow, the third segment yellowish brown, darkest apically; the remaining segments of the flagellum dark brown; the basal enlargement brownish black, the terminal segments almost uniform in color; antennæ rather long and comparatively slender, if bent backward extending about to the base of the abdomen or a little beyond; segments of the flagellum with the basal portion only a little more enlarged than the pedicel; a dense white pubescence on the antennal segments. Head light gray with an indistinct median brown suffusion.

Mesonotal præscutum dull yellow with three broad brown stripes, of which the median one is indistinctly bisected by a paler median line, which in turn encloses a narrow dark brown median vitta; lateral stripes uniform in color, short, beginning far behind the pseudosutural foveæ; pseudosutural foveæ dark brownish black; scutum almost uniformly brown; scutellum and postnotum gray, the latter with a large brown spot on either side of the middle line. Pleura pale, rather densely light gray pruinose. Halteres rather long, light brown, more yellowish at the extreme base. Legs with the coxæ light brown, dusted with gray; trochanters dull yellow; femora brownish yellow, narrowly dark brown at the apex; tibiæ light brown, tipped with darker, the tibial spurs light colored with the apical half chitinized, black; tarsi dark brown. Wings with a

Antennæ longer, the flagellar segments not constricted beyond the basal enlargement: three brown stripes on the mesonotal præscutum; male hypopygium with the ninth tergite having the caudal margin deeply and broadly notched medially; ninth pleurite incomplete; lobes of the caudo-lateral angle of the ninth sternite not pendulous, directed entad: eighth sternite without lobes on the caudal margin ... *dietziana* sp. n.

Tipula cunctans Say.

Tipula cunctans Say; Journal of the Academy of Natural Sciences of Philadelphia, vol. 3, p. 23 (1823).
Tipula casta Loew; Entomologische Zeitschrift, vol. 7, p. 289 (1863).
Tipula infuscata Loew; Entomologische Zeitschrift, vol. 7, p. 289 (1863).

There can be no doubt but that the three names given above represent one and the same species. Under the series of *cunctans* determined as such by Loew, there appears a specimen which bears a manuscript label in Loew's writing and this label is "*infuscata*." The type-series of *casta* and *infuscata*, as well as the series of *cunctans*, all bear the same manuscript number given to the specimens by Osten Sacken (No. 95). In the series of *Tipula cunctans* there are two females dated October 20; it is well known that *infuscata* is one of the few autumnal species of Nearctic Tipula, and this data in regard to *cunctans* only confirms the synonomy of the species.

The Bicornis Group.

The small group of species that constitute this division seem to show the following characters and tendencies: The nasus is very short to indistinct; the coloration is yellow or brownish yellow with the thoracic stripes usually distinct; the body is provided with abundant short hairs on the head and on the thoracic interspaces. The venation shows the cell *1st* M_2 very small and pentagonal (larger and more elongated in *johnsoniana*). The male hypopygium has

vitreous spot before the stigma extending from cell *1st* R_1 into the base of cell M_4. Venation as in other members of the *bicornis* group, but the cell *1st* M_2 is large and less regularly pentagonal (see Plate XVII, fig. 20).

Abdominal tergites bright yellow; a narrow median brown vitta beginning on the base of segment two extending through segment six; segments seven and eight yellow, indistinctly brown medially; the ninth tergite is dark brown, pale medially on the caudal half above; an indistinct sublateral band beginning midlength of the second segment, ending on the seventh segment, on the last three segments oblique; lateral margins broadly, caudal margins narrowly yellowish silvery; sternites dull yellow, narrowly margined with silvery; ninth pleurite and sternite dark brown. Male hypopygium (see Plate XVIII, fig. 40) with the ninth tergite (see Plate XIX, fig. 58) tumid, though not very high, the caudal margin almost transverse with an indistinct median impression; no horns or lobes on the tergite; the ventro-caudal margin on either side of the middle line is produced into a flattened edge whose inner angle is blackened, chitinized, and sparsely denticulate. Ninth pleurite complete, extensive; the caudal margin is produced into a broad, flattened process directed caudad and slightly dorsad and entad; outer pleural appendage small but prominent for this group of species, elongate-cylindrical, pale with a few scattered long hairs; inner pleural appendage a flattened blade which is broad basally, narrowed into a subacute point, the caudal margin ciliate with long yellow hairs. Ninth sternite extensive, the dorso-caudal angle produced entad and slightly ventrad; this process subacute and slightly chitinized; beneath this a shorter lobe with a fringe of long yellow hairs, those

lobes to the middle line beneath; the ventro-caudal edge of the ninth tergite is concave and with an oval notch, the lobes thus formed (see Plate XXI, fig. 83) directed entad, ventrad and slightly caudad, heavily chitinized, minutely denticulate and provided with a few long hairs. Ninth pleurite complete, rather large, subquadrate, the dorso-caudal angle produced caudad and slightly dorsad and entad; lobes two, flattened, fleshy, with numerous long hairs. Ninth sternite rather restricted, the caudal margin beneath broadly concave, the lateral lobes prominent, directed entad and caudad, the tips expanded, truncate, the lobe with numerous long pale hairs on the inner margin; immediately dorsad of this lobe is a small rounded knob bearing numerous hairs; in a position of rest this knob is invisible from beneath. Gonapophyses powerful (see Plate XXI, fig. 82) directed caudad and slightly dorsad; they occupy the ventral portion of the genital chamber, each one consisting of a cylindrical. heavily chitinized horn, slightly divergent apically; a narrow line of short strigose hairs on the outer face of each horn. Eighth sternite large, the caudal margin truncated medially and here with a dense brush of long pale hairs.

The female is in the Loew collection and bears the label in Osten Sacken's writing: authentic ♀, caught with the ♂, from Delaware. The female is quite small, the wing measuring but 15 mm. The abdomen of the allotype is broken off, but another specimen comes close to *bicornis* in the very short valves to the ovipositor.

Habitat.—Eastern United States.

Holotype, ♂, Oaklandon, Hancock Co., Ind., June 8, 1913 (Morrison).

hairy, the distal arm long, slender, subcylindrical. Ninth pleurite rather extensive, the caudal margin produced into two prominent flattened processes, the more dorsal curved toward the tip, the more ventral subspatulate, straight; outer pleural appendage very tiny and reduced, occupying the notch between the tergite and pleurite, fleshy and bearing a few long hairs at the tip; inner pleural appendage elongate, slightly curved, with numerous long hairs on the outer face. Ninth sternite with the dorso-caudal angle produced inward as a long, flattened process which approaches the one of the opposite side on the middle line beneath. The gonapophyses are powerful and divaricated, of the same structure as in *T. morrisoni*. Eighth sternite extensive, the caudal margin indistinctly trilobed, the median area broadly convex and bearing a dense fringe of long reddish hairs; on either side smaller lobes also bearing long hairs.

Habitat.—Northern United States.

♂, Norwich, Vermont; July 8, 1908 (Johnson); 2 ♂'s, 1 ♀, Battle Creek, Michigan (Aldrich).

Tipula parshleyi sp. n.

Coloration dull yellow; antennæ with the basal flagellar segments bicolorous; thoracic stripes indistinct; body with numerous short hairs; male genitalia with the eighth sternite large, enclosing the ninth sternite in its concavity.

Male.—Length, 14.5–15 mm.; wing, 15.2–16.4 mm.; antennæ about 4.6 mm. Fore leg, femora, 9.6 mm.; tibiæ, 11.6 mm.; middle leg, femora, 8.8–9.5 mm.; tibiæ, 9.8–10.3 mm.; hind leg, femora, 8.8–10.2 mm.; tibiæ 10.1–12 mm.

Female.—Length about 15 mm.; wing, 17.5 mm.

Frontal prolongation of the head dull yellow, palpi short, dull

(Shute); No. 9, ♂, Dorchester, Suffolk Co., Mass., No. 482 (Uhler); No. 10, ♂, Eastport, Washington Co., Me., July 15 (Johnson); No. 11, ♀, Barber Dam, New Brunswick, June 25, 1914 (McKenzie); No. 12, ♂, Frederickton, New Brunswick, June 10, 1914 (Tothill); No. 13, ♂, British America (Scudder); No. 14, ♂, Colorado (H. K. Morrison).

Paratype No. 6 bears the label "*scaphula*" in Loew's script.

The type and paratypes 1 to 5 are in the collection of the author; the allotype and paratypes 6 to 9 and 13 in the Museum of Comparative Zoology; paratype 10 in the Boston Society of Natural History; paratypes 11 and 12 in the New Brunswick Experiment Station; paratype 14 in the United States National Museum.

This species is dedicated to my friend and companion, Mr. Howard S. Parshley.

Many specimens, including the type, were taken along the Penobscot River near the Basin Mills during the twilight and early evening. The flies were on the wing and quite active.

Explanation of Plates XVI–XXI.

Plate XVI.—Wing-venation.

Fig. 1.—Wing of *Nephrotoma penumbra*; R_1, R_2, R_3, etc. = radial veins; M_1, M_2, M_4 = medial veins; Cu_2 = cubitus 2; *2nd A* = second anal.
Fig. 2.—Wing of *Tipula* (*Cinctotipula*) *algonquin*.
Fig. 3.— " " *T. pachyrhinoides*.
Fig. 4.— " " *T. penobscot*.
Fig. 5.— " " *T. mainensis*.
Fig. 6.— " " *T. kennicotti*.
Fig. 7.— " " *T. taughannock*, ♀.
Fig. 8.— " " *T. taughannock*, ♂.
Fig. 9.— " " *T. imperfecta*.
Fig. 10.— " " *T. cayuga*.
Fig. 11.— " " *T. triton*.
Fig. 12.— " " *T. loewiana*.
Fig. 13.— " " *T.* [illegible]

Fig. 80.—Penis-guard of *T. tuscarora;* ventral aspect.
Fig. 81.—Penis-guard of *T. rangiferina;* lateral aspect.
Fig. 82.—Gonapophyses of *T. morrisoni;* ventral aspect.
Fig. 83.—Ventro-caudal margin of the ninth tergite of *T. morrisoni;* caudal aspect.
Fig. 84.—Ovipositor of *T. mandan;* lateral aspect. *9t* = ninth tergite; *9s* = ninth sternite.
Fig. 85.—Ovipositor of *T. piliceps;* dorsal aspect.
Fig. 86.—Ovipositor of *T. imperfecta;* dorsal aspect.
Fig. 87.—Ovipositor of *T. parshleyi;* dorsal aspect.

Three examples before me from Lake Cassette do not indicate these variations to be other than local or individual.

Salvelinus alpinus marstoni (Garman).

Head 4 to 4$\frac{3}{4}$; depth 4$\frac{1}{2}$ to 6; D. usually IV, 9, I, rarely IV, 10, I or IV, 8, I; A. usually IV, 8, I, sometimes IV, 9, I; scales in lateral line with tubes about 106 to 123 to caudal base, and 3 to 10 more on latter, the average about 7; 150 to 187 scales counted just above l. l. its entire course to caudal base, and 5 to 12 more on latter: 32 to 34 scales above l. l. to dorsal origin; 30 to 34 scales below l. l. to ventral origin; 68 to 73 predorsal scales; snout 3$\frac{3}{7}$ to 3$\frac{3}{4}$ in head, measured from upper jaw tip; eye 6 to 7$\frac{1}{5}$; maxillary 1$\frac{9}{10}$ to 2$\frac{1}{5}$; interorbital 3$\frac{1}{8}$ to 3$\frac{1}{2}$; gill-rakers of left side usually 8, seldom 7 + 12, of right side usually 8, seldom 9 + 12, rarely 13; total length 12$\frac{5}{8}$ to 14$\frac{3}{4}$ inches, of seven examples.

Color when fresh, back deep olive to dusky, the latter shade mostly over median line and color becoming more rich olive as it descends the sides. Sides, in region of lateral line, marked by well-spaced small red spots ocellated with very pale blue, though these last only present when fish is taken from the water. Head dusky to olive above, sides same, and lower surface whitish, with smutty tinge over branchiostegals. Iris brownish or dusky, with narrow circle of golden about dark pupil. Inside gill-openings pale. Dorsal and caudal dusky-olive, with dusky shades on membranes of former. Pectoral with whitish upper edge, on outer surface grayish medianly above and lower surface orange-red, and on inner surface dark upper median tint dusky-olive. Ventral orange-red, front and hind edges whitish. Anal with front edge whitish, broad distal edge pale orange and base pale dusky. Breast, belly, abdomen, and most all of ventral region orange-red, though much paler posteriorly.

Besides the fishes, several amphibians were also secured. These are: *Bufo americanus* from Black Pond, Charlottetown, and East Lake near Bothwell; *Rana septentrionalis* from Black Pond, between Southport and Lake Verde, Tignish, and from large swamp in Dundee; and *Rana sylvatica* from near Charlottetown.

Salvelinus fontinalis (Mitchill).

Young from near Southport and near Village Green.

Anguilla rostrata (Le Sueur).

North Lake.

Fundulus heteroclitus badius Garman.

Tignish, North Lake, East Lake near Bothwell, Grand Tracidie, Black Pond and Fullerton Marsh at Bunbury.

Pygosteus pungitius (Linnæus).

Abundant in spring-brook at Charlottetown and spring-head of Hillsboro River at Southport.

Gasterosteus aculeatus Linnæus.

Common with *Pygosteus* at Charlottetown and Southport; Bloomfield; swamp at Dundee.

Apeltes quadracus (Mitchill).

East Lake near Bothwell.

Magdalen Islands.

Mr. Long also made a small collection of fresh-water fishes here in July and August of 1912.

Fundulus heteroclitus badius Garman.

Adult and young at Grindstone.

Pygosteus pungitius (Linnæus).

[redacted]

THE FISHES OF TRINIDAD, GRENADA, AND ST. LUCIA, BRITISH WEST INDIES.

BY HENRY W. FOWLER.

In February and March of 1915 Mr. Richard M. Abbott visited various of the Lesser Antilles, and while at the above-named islands made several collections of fishes. Through his generosity, these have all been received as gifts to the museum of the Academy.

TRINIDAD.

The collection from this island is the most extensive. It was made chiefly in the fish-market of Port-of-Spain, from February 27 to March 7. The market fishes are all taken in the Gulf of Paria, brought to town, and there disposed of as food. The waters of the Gulf of Paria are continually discolored, so that they have a muddy color. This has been explained as due to the vast quantities of river deposits, silt, etc., carried down the Orinoco and through its delta out into the sea. The shore currents then carry the soiled and less saline waters north into the more or less enclosed gulf, where they apparently are unable to clear. Apparently continuously muddied, the water supports a rich fish-fauna. A few of the larger species were seen in the market, and though carefully noted, were not preserved. They are included below with this reservation.

No account of the marine fishes of Trinidad has ever appeared.

Albula vulpes (Linnæus).

Small example 5$\frac{3}{8}$ inches long. Back with about ten narrow transverse brownish bars, fading out below lateral line.

Tarpon atlanticus (Valenciennes).

Megalops thrissoides Günther, Cat. VII, 1868, p. 472.

Clupanodon pseudohispanicus (Poey).

One example 5$\frac{1}{2}$ inches long.

Sardinella macrophthalma (Ranzani).

Two small examples, 2$\frac{9}{16}$ inches.

Sardinella humeralis (Valenciennes).

Clupea humeralis Günther, *l.c.*, p. 422.

Five adults, the two smaller showing little more dusky about tip of upper caudal lobe. Length 4$\frac{3}{16}$ to 5$\frac{1}{2}$ inches.

Opisthonema oglinum (Le Sueur).

Clupea thrissa Günther, *l.c.*, p. 432.

Six examples, 5$\frac{1}{8}$ to 7$\frac{3}{4}$ inches.

Anchovia abbotti sp. nov. Fig. 1.

Head 4$\frac{1}{2}$; depth 3$\frac{7}{8}$; D. III, 11; A. III, 24, I; P. I, 15; V. I, 6; scales about 40 in lateral series (squamation injured) + 4 more on caudal base; about 9 scales between dorsal origin and middle of belly; about 22 predorsal scales; head width about half its length; head depth at occiput 1$\frac{2}{5}$; dorsal base 1$\frac{3}{5}$; least depth of caudal peduncle 2$\frac{1}{8}$; first branched anal ray about 1$\frac{7}{8}$; pectoral 1$\frac{1}{3}$; ventral 2$\frac{3}{5}$; snout 6 in head; eye 4$\frac{2}{3}$; maxillary 1$\frac{1}{8}$; interorbital 4$\frac{3}{4}$.

Body elongate, rather plump, compressed, profiles more or less similar, greatest depth at dorsal origin, and edges all convex. Caudal peduncle compressed, least depth 1$\frac{1}{2}$ its length.

front rays elongate, and graduated down from first branched. Anal origin about opposite first fourth in dorsal length, front rays elongate and graduated down from first branched rays, fin low behind. Caudal deeply forked, lobes pointed and nearly equal. Pectoral pointed, reaches ventral. Latter inserted little nearer pectoral than anal, half way to vent, which close before anal or well behind dorsal origin.

Color in alcohol, when fresh, upper surface of back very pale olive, inclining to pale yellowish. Head, sides and lower surface bright silvery-white, and apparently no distinct lateral band lengthwise. Iris whitish, also fins. Dorsal and caudal very slightly tinted grayish, latter yellowish basally and hind edge distinctly blackish its entire extent.

Length $7\frac{1}{4}$ inches.

Type, No. 45,079, A. N. S. P. Port-of-Spain, Trinidad, British West Indies. February–March, 1915. Richard M. Abbott.

Only the above example was obtained. I first thought this must be *Stolephorus surinamensis* Bleeker,[9] a species formerly wrongly identified by most writers with *Engraulis clupeoides* Swainson. It differs, however, from Bleeker's species in several respects, and therefore for the present it may be regarded as distinct. Bleeker's examples were 96 mm. long, and are described with the scales as 35, the fins yellowish and the caudal broadly edged brownish behind. Dr. Eigenmann gives [10] 35 gill-rakers on the lower arch of *A. surinamensis*.

(Named for Mr. Richard M. Abbott, who collected the type.)

Anchovia filifera sp. nov. Fig. 2.

Head $3\frac{1}{2}$; depth $4\frac{3}{4}$; D. III, 12; A. III, 21, I; scales about 36 in lateral series to caudal base + 4 more on latter; 8 scales between

distance, forming narrow free fold over anterior trenchant keel of isthmus at that point.

Scales caducous, mostly fallen, narrowly imbricated, arranged in even lengthwise rows, each with about 5 vertical striæ, and all of more or less uniform size. Dorsal and anal depressible within broad basal scaly sheaths. Caudal base scaly, and each lobe with small crowded scales. Pectoral with free pointed axillary scale half length of fin. Similar ventral axillary scale but slightly shorter than fin.

Dorsal origin midway between snout tip and caudal base, graduated down from first branched ray which longest, and tips of front rays not extended far back as tips of last rays. Anal origin slightly before end of dorsal base, or about midway between pectoral origin and caudal base, and graduated down from first branched or longest ray. Caudal well forked, pointed lobes about equal. Pectoral with uppermost ray greatly elongated, extending back nearly far as end of depressed ventral, or if this ray removed fin almost reaching ventral. Ventral inserted little nearer pectoral than anal, reaching about half way to latter. Vent close before anal.

Color in alcohol largely whitish, sides with somewhat translucent appearance. Back and upper surface of head dotted with dusky under slight or pale olive ground-color. Sides of head and iris bright silvery-white. Dorsal pale or grayish, dusky dots on basal scaly sheath. Caudal conspicuously dusky. Row of underlaid and rather obscure pale dusky dots along base of anal. Other fins whitish. Side with broad silvery-white lateral band, expanded over anal and along side of caudal peduncle till wide as eye.

[redacted]

tinuous in front of upper jaw. Similar teeth in mandible, not continuous over front of jaw, which has slight knob. Row of minute teeth on vomer and palatines, and of larger size on pterygoids. Tongue small rounded smooth knob in front of mouth. Upper surface of basibranchial shaft finely asperous. Mandible convex over surface, rami not elevated inside mouth. Mandible included within upper jaw, so that its tip extends slightly before front nostril. Nostrils small, together, nearer eye than snout tip. Interorbital broadly convex. Each supraorbital ridge distinct, slopes up straight to nape, flaring out little in front. Cheek would form an isosceles triangle. Skin on top of head, cheeks and opercles with numerous minute tubercles and little depressions or pits.

Gill-opening forward about opposite first third in eye. Rakers 18 + 20, slender, compressed, pointed, inner edges well denticulated, about $1\frac{1}{2}$ in eye. Filaments 2 in eye. Pseudobranchiæ 3 in eye. Isthmus rather long, slender, lower edge slightly convex. Branchiostegals 11, membranes slightly united as free fold across isthmus in front.

Scales very loose, narrowly imbricated, arranged in even lengthwise rows, more or less uniform in size. Each scale with rather numerous reticulating striæ. Caudal base scaly. Dorsal and anal with well-developed basal scaly sheaths. Pectoral with long pointed axillary scale slightly less than half length of fin. Ventral with free pointed axillary scale, about $\frac{2}{3}$ length of fin. Both pectorals and ventrals with lower broad scaly flaps.

Dorsal origin midway between hind eye edge and caudal base, first branched rays longest, extends back further when depressed than tips of last rays. Anal origin slightly behind dorsal origin,

Hoplosternum thoracatum (Valenciennes).

C. thoracatus Günther, *l.c.*, p. 228.
—— Regan, *l.c.*

Corydoras æneus (Gill).

Hoplosternum æneum Gill, *l.c.*, p. 403.
Corydorus æneus Regan, *l.c.*

Plecostomus plecostomus (Linnæus).

P. guacari Regan, *l.c.*, p. 389.
Hypostomus robinii (non Valenciennes) Gill, *l.c.*

Plecostomus robinii Valenciennes.

P. robini Regan, *l.c.*

Lasiancistrus guacharote (Valenciennes).

Ancistrus guacharote Gill, *l.c.*, p. 409.
A. trinitatis Regan, *l.c.*

Ancistrus cirrhosus (Valenciennes).

Xenochara cirrhosum Regan, *l.c.*

Curimatus argenteus Gill.

L.c., p. 289.
—— Regan, *l.c.*, p. 385, Pl. 21, fig. 3. Ravines of Streatham Lodge Estate.

Odontostilbe pulcher (Gill).

Pœcilurichthys pulcher Gill, *l.c.*, p. 419.
Chirodon pulcher Regan, *l.c.*, Pl. 22, fig. 2. Cumuto.

Astyanax bimaculatus (Linnæus).

P. bimaculatus Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 261. San Juan.
P. brevoortii Gill, *l.c.*, p. 417.
Tetragonopterus maculatus Regan, *l.c.*, p. 384. Maracas River.

Four examples from Diego Martin River, near Port-of-Spain. Length $1\frac{1}{16}$ to $2\frac{1}{16}$ inches.

Astyanax tæniurus (Gill).

P. tæniurus Gill, *l.c.*, p. 418.
T. tæniurus Regan, *l.c.*, p. 383, Pl. 22, fig. 4.
T. trinitatis Regan, *l.c.*, p. 384.

Sphyræna guachancho Valenciennes.

One $10\frac{11}{16}$ inches long. A large one seen at St. Kitts was likely *S. barracuda* (Walbaum).

Mugil brasiliensis Agassiz.

—— Regan, *l.c.*, p. 391.

Several large gray mullets about 15 inches long, seen in the markets, were likely this species.

Mugil trichodon Poey.

—— Regan, *l.c.*

Agonostomus monticola (Bancroft).

—— Regan, *l.c.*

Agonostomus percoides Günther.

—— Regan, Biol. C. Amer. Pisc., 1906–8, p. 69.

Sarda sarda (Bloch).

Several seen in markets, but with the next, not preserved.

Scomberomorus regalis (Bloch).

Not uncommon in the market.

Trichiurus lepturus Linnæus.

One 19 inches long.

Oligoplites saurus (Schneider).

Chorinemus occidentalis Günther, *l.c.*, II, 1860, p. 475.

Two small ones, $4\frac{3}{4}$ and $6\frac{3}{4}$ inches long. They agree with large ones from Fort Macon, N. C. The species reaches a large size, examples of about 30 inches in length being seen in the markets. The fins are bright yellow.

Mycteroperca dimidiata (Poey).

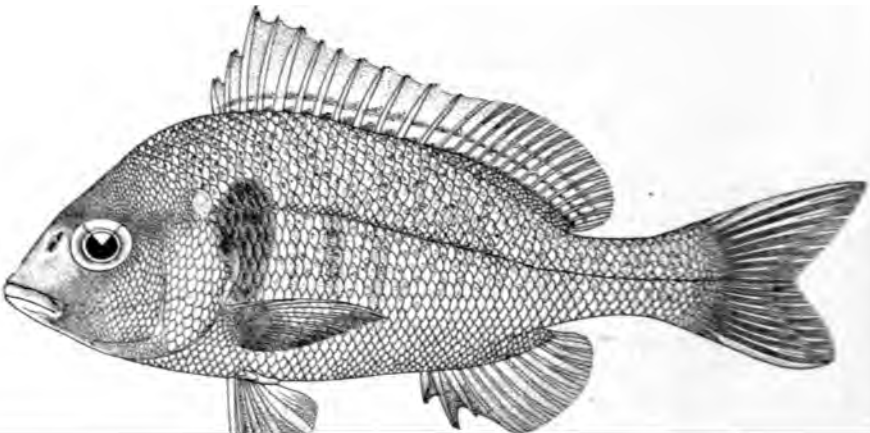
Head $2\frac{2}{5}$; depth $3\frac{1}{5}$; D. XI, 16, I; A. III, 12, I; scales about 100 in lateral line to caudal base, and 15 more on latter; tubes 83 in lateral line to caudal base, and about 15 more on latter; 17 scales between soft dorsal origin and lateral line; 31 scales in vertical series between spinous anal origin and lateral line; snout $3\frac{1}{2}$ in head measured from upper jaw tip; eye $5\frac{1}{3}$; maxillary $2\frac{1}{4}$; interorbital $5\frac{3}{4}$. Body well compressed, contour elongately ellipsoid. Head large. Snout about long as wide. Eye high, little ellipsoid, centre about first $\frac{2}{5}$ in head. Mouth large, lower jaw well protruded. Maxillary reaches opposite eye centre. Bands of conic teeth in jaws, inner depressible and enlarged little in front of upper and along sides of lower. Pair of firm erect outer wide-set canines above. Row of small teeth on vomer and palatines. Nostrils close, front one little larger and at last fourth in snout. Interorbital slightly convex. Preopercle angle rather salient, with slightly enlarged serræ. Rakers VII, 3 + 11, VII, lanceolate, $1\frac{1}{2}$ in eye. Scales crowded along edges of body, small, cycloid on predorsal, head and chest, otherwise mostly ciliated. Lateral line concurrent with dorsal profile. Dorsal spines pungent, fourth longest and first shortest. Rayed dorsal and anal alike, rounded. Anal spines graduated up to third, which longest. Caudal truncate, $1\frac{1}{2}$ in head. Pectoral large, $1\frac{3}{4}$ in head. Ventral reaches vent, though not quite to anal, $2\frac{1}{8}$ in head. Color in alcohol mostly deep brown, paler below and clouded with whitish. Pale yellowish tints on lower surface of head. Iris yellowish and dusky. Indistinct pale ring around caudal peduncle, behind which above on rudimentary caudal rays inconspicuous small dusky or blackish saddle. Vertical fins

Bathystoma striatum (Linnæus).

One example, 6 inches long. General color leaden above, white below. Body with five bright gilt lengthwise bands. Iris gray-yellow. Inside mouth red. Fins largely gray.

Orthopristis scapularis sp. nov. Fig. 4.

Head $2\frac{7}{8}$; depth $2\frac{2}{3}$; D. XII, 15, I; A. III, 10, I; P. I, 16; V. I, 5; scales 52 in lateral line to caudal base, and 8 more on latter; 10 scales between spinous dorsal origin and l.l., and same between soft dorsal origin and l.l.; 16 scales in vertical series between spinous anal origin and l.l.; 36 scales before spinous dorsal; snout $2\frac{2}{3}$ in head; eye $3\frac{2}{3}$; maxillary 3; interorbital $3\frac{3}{5}$; third dorsal spine $2\frac{1}{5}$; first branched dorsal ray $3\frac{1}{6}$; second anal spine $3\frac{1}{4}$; first branched anal ray $2\frac{1}{2}$; least depth of caudal peduncle 3; upper caudal lobe $1\frac{1}{5}$; pectoral $1\frac{2}{5}$; ventral $1\frac{1}{2}$.



dull brownish vertical streaks. Under surface of body more or less marbled with whitish, darker color producing soiled appearance. Iris silvery, with grayish tints. Mandible whitish. Mouth pale in front, though within pharynx and gill-opening brilliant orange. Dorsals grayish, basally with dusky lengthwise band, above this whitish band bordered above by another dusky band. All area above on spinous fin dark, though on rayed fin behind another short paler lengthwise band. Anals grayish, also pectorals and caudal, latter very obscurely with several faint vertical darker cross bands. Ventrals dusky-gray, front edge whitish, and ends with few whitish mottlings.

Length $6\frac{3}{4}$ inches.

Type, No. 45,084, A. N. S. P. Port-of-Spain, Trinidad, British West Indies. February–March, 1915. Richard M. Abbott.

Only the type secured. This interesting species is related to *Orthopristis chrysopterus* (Linnæus) from the northern waters of the Gulf of Mexico and the United States. It differs at once in its fewer anal rays, fewer scales and coloration.

(*Scapularis*, shoulder, with reference to the dark blotch.)

Conodon nobilis (Linnæus).

C. nobilis Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 261.

Brachydeuterus corvinæformis (Steindachner).

One $5\frac{7}{8}$ inches long.

Calamus calamus (Valenciennes).

Chrysophrys calamus Günther, Cat. F. Brit. Mus., I, 1859, p. 487.

Abundant in the markets, though none preserved.

Archosargus unimaculatus (Bloch).

Polycentrus schomburgkii Müller and Troschel.

—— Regan, Proc. Z. Soc. London, 1906, p. 391, Pl. 25, fig. 2.
P. tricolor Gill, Ann. Lyc. N. Hist. N. Y., VI, 1858, p. 371.

Æquidens pulcher (Gill).

Cychlasoma pulchrum Gill, *l.c.*, p. 22.
Acara pulchra Regan, *l.c.*, p. 392, Pl. 25, fig. 1.
Æquidens pulcher Fowler, Proc. Acad. Nat. Sci. Phila., 1915, p. 261. St. Joseph and Blue Basin.

Cichlasoma bimaculatum (Linnæus).

—— Regan, *l.c.*
Cychlasoma tænia Gill, *l.c.*

Crenicichla saxatilis (Linnæus).

—— Regan, *l.c.*, 1905, p. 159; *l.c.*, 1906, p. 391.
C. frenata Gill, *l.c.*

Iridio kirschii Jordan and Evermann.

One 6 inches.

Iridio maculipinna (Müller and Troschel).

Platyglossus maculipinna Günther, Cat. F. Brit. Mus., IV, 1862, p. 165.

Cryptotomus ustus (Valenciennes).

Callyodon ustus Günther, *l.c.*, p. 214.

One example, $6\frac{3}{8}$ inches long. Color when fresh generally bluish-green, with irregular pale purplish-brown blotches, also several ill-defined underlaid lengthwise tints of same shade. In some lights body shows brilliant purple and violet reflections. Under surface of head and trunk whitish. Narrow blue line from eye to mouth, and short bar behind above. Iris whitish, narrow green circle bordering pupil. Dorsals and anals pale gray, mottled finely with darker tints. Caudal dull red, spotted with purple, spots smaller than eye and most evident on middle near base. Pectoral

Chilomycterus antillarum Jordan and Rutter.

One example $2\frac{13}{16}$ inches long. Many examples of *Diodon hystrix* Linnæus, seen in the curio-shops of Barbadoes, some doubtless obtained in this vicinity.

Scorpæna brasiliensis Valenciennes.

One $6\frac{1}{8}$ inches long. It shows a supra-occipital tentacle well developed and a narrow infra-orbital.

Scorpæna bergii Evermann and Marsh.

One example 4 inches long. It differs from the original account and figure in the presence of a much longer supra-orbital tentacle.

Cephalacanthus volitans (Linnæus).

Dactylopterus volitans Günther, *l.c.*, II, 1860, p. 221.

One $4\frac{1}{2}$ inches.

Cyclopsetta chittendeni B. A. Bean.

Proc. U. S. Nat. Mus., 1894, p. 635.

Citharichthys spilopterus Günther.

Two $3\frac{3}{4}$ and $3\frac{7}{8}$ inches long.

Etropus microstomus (Gill).

One example, $4\frac{1}{8}$ inches long. A comparison with examples from Ocean City, N. J., and Wallops Island, Va., shows no specific difference, though a wide range of variation. This latter shows *E. rimosus* Goode and Bean as a synonym, and possibly *E. crossotus* Jordan and Gilbert also.

Achirus lineatus (Linnæus).

One 7 inches.

Philypnus dormitor (Lacépède).

—— Regan, Proc. Zool. Soc. London, 1906, p. 392. Caroni River.

Dormitator maculatus (Bloch).

Myoteroperca falcata (Poey).

E. facatus Boulenger, *l.c.*, p. 261.

Hypoplectrus unicolor guttavarius (Poey).

Back, caudal peduncle and sides above rich dark blue-black when fresh, same color also extending on bases of both dorsals. Rest of body, including predorsal region and all fins, brilliant orange. Iris same, though orange fading white in alcohol. Both dorsals, anals and ventrals all very narrowly and inconspicuously edged with black. Broad blue-black bar from each side of snout tip to eye, edged on each side by narrower bar of cobalt-blue, which also with still outer narrower dusky marginal streak. Lower sides of body with dusky diffused in brilliant orange. Length $5\frac{1}{4}$ inches.

Ocyurus chrysurus (Bloch).

One $5\frac{7}{8}$ inches long.

Iridio garnoti (Valenciennes).

Color when fresh, back neutral tint, greenish-yellow in front above, centre of each scale more olive-green. After depressed pectoral vertical ill-defined broad purplish-black streak towards anal, fading out below. Behind vertical bar all upper surface of body and sides purplish-neutral shade, middle of each scale darker. Head, belly and lower sides tinged dull purple-gray, darker tint across mandible below, leaving broad whitish or pale lower lip. Iris blue-green, narrow circle of gold around pupil. From upper hind eye edge two narrow blackish lines towards spinous dorsal origin, above and behind several small scattered blackish dots, inconspicuous. Snout, interorbital and opercular region, little darker than rest of head. Both dorsals with very narrow whitish edge, general color slaty to purplish-gray, though on median and basal portions its

[illegible]

Color when fresh [illegible] olive-green, [illegible] larger. [illegible] after head above pectorals [illegible] [illegible]. Head [illegible] green band from [illegible] forward to mouth, continued back [illegible] then down along [illegible] of [illegible] [illegible] forward to mouth. [illegible] lower jaw and [illegible] white [illegible]. [illegible] from eye [illegible] toward [illegible] [illegible] yellow [illegible] pectoral region. [illegible] green [illegible] with pale-green lines. [illegible] blue-black [illegible] little larger than pupil. [illegible] greenish spots [illegible] pectoral irregularly. [illegible] base with [illegible] wedge-shaped mark. [illegible] green narrow [illegible] brilliant [illegible]. [illegible] pectoral [illegible]. [illegible] with larger [illegible] two [illegible] within narrow [illegible] and edges narrowly whitish with narrow submarginal [illegible] line. [illegible] larger [illegible] median area [illegible] lengthwise crimson band. Upper edge [illegible] lower straight. [illegible] bordering line. [illegible] edge narrowly whitish, with [illegible] line submarginally of brownish. Caudal brilliant [illegible] with [illegible] above and another [illegible] narrower median line. Upper and lower corners [illegible] with several irregular [illegible]. Pectoral and ventral [illegible] former with [illegible] pale turquoise. [illegible] with [illegible]. Length 4½ inches. It agrees with

"The structural relations of some Devonian shales in Central New York," by Burnett Smith (November 1).

The issue of the JOURNAL, Volume XVI, No. 2, was reported.

The following minute was unanimously adopted and ordered to be duly signed and forwarded:

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA hears with lively satisfaction of the completion of the *Biologia Centrali Americana*, sixty-three volumes of which have appeared from 1879 to the present year. Recognizing the unwearied devotion of its founder and editor, DR. FREDERIC DUCANE GODMAN, to the collection of material, its study by specialists, and the sumptuous publication of the results, this Academy tenders its hearty congratulations to him, its distinguished corresponding member.

The following were elected Correspondents:

Alfred C. Haddon, Sc.D., of Cambridge, England.
William Ludwig Johannsen, M.D., of Copenhagen.
William Trelease, LL.D., of Urbana, Ill.
William Bateson, of Merton, England.
Carl Diener, Ph.D., of Vienna.
Samuel Wendell Williston, Ph.D., of Chicago.
Charles E. Barrois, of Paris.
Thomas Chrowder Chamberlin, LL.D., of Chicago.
Albrecht Pench, Ph.D., of Berlin.
Stanislas Meunier, D.Sc., of Paris.

The following was ordered to be published:

Truncilla triquetra Raf.

Truncilla triqueter (*Unio triqueter*) Raf. Monogr. (1820), p. 300, No. 18, Pl. 81, figs. 1, 2, 3, 4.

The type is A. N. S. P. Coll. No. 20,231.

Length 55, height 37, diam. 32.5 mm.

This is *Truncilla triquetra* Raf. of Simps. Synopsis, p. 517, and A Descriptive Catalogue of the Naiades by C. T. Simpson, Detroit (1914), p. 5.

Truncilla brevidens Lea.

Obliquaria interrupta (*U. do.*) Raf. Monogr. (1820), p. 302, No. 21.

The type is A. N. S. P. Coll. No. 20,257, from the Ohio River.

Length 55.5, height 43, diam. 26.5 mm.

This is *Truncilla brevidens* Lea (1834) of Simps. Synopsis, p. 517, and Descr. Catal., p. 7. It is preoccupied by *Unio solenoides interrupta* Raf. (1820), p. 298, No. 13, var. 1.

Truncilla obliqua Raf.

Obliquaria obliquata (*U. obliquata*) Raf. Monogr. (1820), p. 309, No. 40.

The type is A. N. S. P. Coll. No. 20,226, from the Kentucky River.

Length 59, height 43, diam. 32.5 mm.

This is *Truncilla sulcata* Lea (1830) of Simps. Synops., p. 520, Descr. Catal., p. 14. It is the first name for the species. *Unio sulcatus* Lea (1830) is preoccupied by *Unio cuneata var. sulcata* Raf. Monogr. (1820), p. 313, No. 52, var. 2.

Truncilla torulosa Raf.

Amblema torulosa (*Unio torulosa*) Raf. Monogr. (1820), p. 314, Pl. 82, figs. 11, 12.

The types are A. N. S. P. Coll. No. 20,218. This is the figured specimen.

Length 65, height 48, diam. 33.5 mm.

This is *Lampsilis leptodon* Raf. of Simps. Synops., p. 575, Descr. Catal., p. 188.

Lampsilis fragilis Raf.

Unio fragilis (*Elliptio fragilis*) Raf. Monogr. (1820), p. 295, No. 16.

The type is A. N. S. P. Coll. No. 20,209, from creeks in Kentucky. Length 97, height 64, diam. 32 mm.

This is *Lampsilis gracilis* Bar. (1823) of Simps. Synops., p. 573, Descr. Catal., p. 182.

Lampsilis alatus Say.

Metaptera megaptera (*Unio megaptera*) Raf. Monogr. (1820), p. 300, No. 17, Pl. 80, figs. 20, 21, 22.

The type is A. N. S. P. Coll. No. 20,211, from the Ohio River. Length 141, height 100, diam. 50 mm.

This is *Lampsilis alatus* Say (1816) of Simps. Synopsis, p. 567, Descr. Catal., p. 162.

Obovaria retusa Lam.

Obovaria torsa (*Unio torsa*) Raf. Monogr. (1820), p. 311, No. 46, Pl. 82, figs. 1, 2, 3.

The type is A. N. S. P. Coll. No. 20,256, from the Kentucky River. Length 56, height 57, diam. 36 mm.

This is *Obovaria retusa* Lam. (1819) of Simps. Synops., p. 599, Descr. Catal., p. 290.

Obovaria subrotunda Raf.

Obliquaria subrotunda (*U. subrotunda*) Raf. Monogr. (1820), p. 308, No. 38, Pl. 81, figs. 21, 22, 23.

This shell is A. N. S. P. Coll. No. 20,254, from the Kentucky River. Length 26.5, height 25.5, diam. 19 mm.

This is not *Unio subrotunda* Lea (1831).

Tritogonia verrucosa Raf.

Obliquaria verrucosa (*U. verrucosa*) Raf. Monogr. (1820), p. 304, No. 26. Pl. 81, figs. 10, 11, 12.

The types are A. N. S. P. Coll. No. 20,235, from the Ohio River.

Length 100, height 56, diam. 32 mm.

Length 93, height 53, diam. 28 mm.

This is *Tritogonia tuberculata* Bar. (1823) of Simps. Synops., p. 608, Descr. Catal., p. 318. *Unio tuberculata* Bar. (1823) is preoccupied by *Unio tuberculata* Raf. Monogr. (1820), pp. 308, 311, 312.

Cyprogenia stegaria Raf.

Obovaria stegaria (*Unio stegaria*) Raf. Monogr. (1820), p. 312, No. 49, Pl. 82, figs. 4, 5, var. 1, *tuberculata* Raf.

The type is A. N. S. P. Coll. No. 20,241, from the Ohio River.

Length 47, height 49, diam. 32 mm.

This is *Cyprogenia irrorata* Lea (1830) of Simps. Synops., p. 610, Descr. Catal., p. 326. The name *tuberculata* is preoccupied by Raf. Monogr. (1820), p. 308, No. 37.

Obliquaria reflexa Raf.

Obliquaria reflexa (*U. reflexa*) Raf. Monogr. (1820), p. 306, No. 31.

The types are A. N. S. P. Coll. No. 20,206, from Letart Falls.

Length 54, height 49, diam. 34 mm.

Length 50.5, height 46.5, diam. 35 mm.

This is *Obliquaria reflexa* Raf. of Simps. Synops., p. 611, Descr. Catal., p. 330.

Ptychobranchus fasciolaris Raf.

Obliquaria fasciolaris (*U. fasciolaris*) Raf. Monogr. (1820), p. 303, No. 25.

The type is A. N. S. P. Coll. No. 20,253, from the Kentucky River.

Length 81, height 49, diam. 28 mm.

This is *Ptychobranchus phaseolus* Hild. (1828) of Simps. Synops.,

I believe *Pleurobema mytiloides* (*U. mytiloides*) Raf. Monogr. (1820) p. 313, No. 51, Pl. 82, figs. 8, 9, 10, is also *P. clava* Lam., but unfortunately the type is not in the collection here.

Pleurobema cyphia Raf.

Obliquaria cyphya (*U. cyphia*) Raf. Monogr. (1820), p. 305, No. 29.

The type is A. N. S. P. Coll. No. 20,239, from the Ohio River.

Length 83, height 58, diam. 36 mm.

This is *Pleurobema æsopus* Green (1827) of Simps. Synops., p. 764, Descr. Catal., p. 806.

Quadrula costata Raf.

Amblema costata (*Unio costata*) Raf. Monogr. (1820), p. 315, No. 57, Pl. 82, figs. 13, 14.

The type is A. N. S. P. Coll. No. 20,246, from small creeks in Kentucky.

Length 66, height 53, diam. 24 mm.

This is *Quadrula undulata* Bar. (1823) of Simps. Synops., p. 569, Descr. Catal., p. 819.

Quadrula cylindricus Say.

Unio solenoides (*Elliptio solenoides*) Raf. Monogr. (1820), p. 298, No. 13.

The type is A. N. S. P. Coll. No. 20,204, from the Ohio River.

Length 73, height 32.5, diam. 27 mm.

This is *Quadrula cylindricus* Say (1816) of Simps. Synops., p. 773, Descr. Catal., p. 832.

Quadrula metanevra Raf.

Obliquaria metanevra (*Unio metanevra*) Raf. Monogr. (1820), p. 305, No. 30, Pl. 81, figs. 15, 16.

The types are A. N. S. P. Coll. No. 20,238, from the Ohio River.

Length 87, height 68, diam. 51 mm.

Length 31, height 27, diam. 12 mm.

Length 31, height 26, diam. 7 mm.

This is probably *Quadrula pustulosa* Lea (1831) of Simps. Synops., p. 780, Descr. Catal., p. 848.

This is not *Unio retusa* Lam. (1819).

Quadrula pustulosa pernodosa Lea.

Obliquaria bullata (*U. bullata*) Raf. Monogr. (1820), p. 307, No. 36.

The type is A. N. S. P. Coll. No. 20,250, from the Kentucky River

Length 54, height 52, diam. 28.5 mm.

This is *Quadrula pustulosa pernodosa* Lea (1845) of Simps. Synops., p. 780, Descr. Catal., p. 851. This name *U. bullata* Raf. is preoccupied by *Unio flexuosa var. bullata* Raf. Monogr. (1820), p. 307, No. 33, var. 1.

Quadrula nodulata Raf.

Obliquaria nodulata (*Unio nodulata*) Raf. Monogr. (1820), p. 307, No. 34, Pl. 81, figs. 17, 18.

The types are A. N. S. P. Coll. No. 20,225, from the Kentucky River.

Length 51, height 43.5, diam. 31 mm.

Length 29.5, height 21.5, diam. 8 mm. (one valve).

This is *Quadrula pustulata* Lea (1834) of Simps. Synops., p. 781, Descr. Catal., p. 856.

Quadrula flava Raf.

Obliquaria flava (*U. flava*) Raf. Monogr. (1820), p. 305, No. 28, Pl. 81, figs. 13, 14.

The type is A. N. S. P. Coll. No. 20,230, from small creeks in Kentucky.

Length 46, height 36, diam. 18 mm.

This is *Quadrula rubiginosa* Lea (1829) of Simps. Synops., p. 786, Descr. Catal., p. 872.

Quadrula obliqua Lam.

Obliquaria lateralis (*U. lateralis*) Raf. Monogr. (1820), p. 310, No. 43.

The types are two valves, A. N. S. P. Coll. No. 20,247, from the Kentucky River.

Length 75, height 67, diam. 20 mm.

Length 71, height 62, diam. 20 mm.

This is *Quadrula obliqua* Lam. (1819) of Simps. Synops., p. 788. Descr. Catal., p. 881.

Quadrula rubra Raf.

Obliquaria rubra (*U. rubra*) Raf. Monogr. (1820), p. 214, No. 54.

The type is A. N. S. P. Coll. No. 20,237.

Length 87, height 66, diam. 40 mm.

This is *Quadrula pyramidata* Lea (1834) of Simps. Synops., p. 790, Descr. Catal., p. 888.

Quadrula cordata Raf.

Obovaria cordata (*Unio cordata*) Raf. Monogr. (1820), p. 312, No. 50, Pl. 82, figs. 6, 7.

The type is A. N. S. P. Coll. No. 20,221, one valve, from the Ohio River.

Length 61, height 63, diam. 19 mm.

This is *Quadrula plena* Lea (1840) of Simps. Synops., p. 790, Descr. Catal., p. 886.

Quadrula sintoxia Raf.

Obliquaria sintoxia (*Unio sintoxia*) Raf. Monogr. (1820), p. 310, No. 44.

The type is A. N. S. P. Coll. No. 20,208, from the Ohio River.

Length 97, height 71, diam. 41.5 mm.

This is *Quadrula subrotunda* Lea (1831) of Simps. Synops., p. 791, Descr. Catal., p. 892. *Unio subrotunda* Lea (1831) is preoccupied by *Unio subrotunda* Raf. Monogr. (1820), p. 308, No. 38.

Quadrula obovalis Raf.

Obovaria obovalis (*Unio obovalis*) Raf. Monogr. (1820), p. 311, No. 45.

The type is A. N. S. P. Coll. No. 20,224, from the Ohio River.

Length 41, height 46.5, diam. 29 mm.

This is *Quadrula ebenus* Lea (1831) of Simps. Synops., p. 793, Descr. Catal., p. 897.

Quadrula tuberculata Raf.

Obliquaria tuberculata (*U. tuberculata*) Raf. Monogr. (1820), p. 308, No. 37.

The type is A. N. S. P. Coll. No. 20,215, from the Ohio River.

Length 59, height 54, diam. 29 mm.

[redacted]

Unio rafinesquei n. n.

I propose the name *Unio rafinesquei* for *Unio fuscatus* Lea, Obs. iv, p. 35, Pl. 40, fig. 4 (not *U. fuscata* Raf. 1820); Simps. Synopsis, p. 717; Descr. Catal., p. 643.

Pleurobema simpsoni n. n.

I propose the name *Pleurobema simpsoni* for *Unio striatus* Lea, Obs. iii, p. 41, Pl. 12, fig. 16 (not *U. striata* Raf. 1820); Simps. Synopsis, p. 762; Descr. Catal., p. 795.

Pleurobema conradi n. n.

I propose the name *Pleurobema conradi* for *Unio maculatus* Conr. New. F. W. Shells (1834), p. 30, Pl. 4, fig. 4 (not *U. maculata* Raf. 1820); Simps. Synops., p. 746; Descr. Catal., p. 737.

DECEMBER 21.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Twenty-seven persons present.

The Chair announced the death of Geo. D. McCreary, a member, July 26, 1915.

The Publication Committee reported the reception of a paper entitled, "Revising of Cayuga Lake Spiders," by Nathan Banks (December 2).

The following was ordered to be printed:

is now grouped with the other layers down to the Onondaga under one formational term, Marcellus.[2]

As used by Vanuxem,[3] the term Marcellus apparently embraced a still higher shale of gray color. This latter was given a separate name by Clarke and Luther who in 1904 called it the Cardiff shale.[4] In the type region (on the Tully quadrangle) the change from the Marcellus is most gradual while above the Cardiff is defined as terminating some 20 feet below a thin band of limestone.[5] This limestone is grouped with the 20 feet of shale below and some hundreds of feet above under a single formational term, Skaneateles.

These general stratigraphic relations appear to hold good for central Onondaga County, but on tracing the formations westward deviations from the type section are noticed. It is now proposed to present the evidence for these deviations.

Just south of Mottville, on the Skaneateles quadrangle, occurs a fossiliferous zone which is well displayed along the outlet of Skaneateles Lake. The section at this point shows a thickness of about 25 feet. In the lower part the shale is gray and thinly bedded with small fossils numerous. Above come small concretions and a limy band full of crinoid fragments. This latter is in turn overlaid by a rather coarse and thickly bedded shale, also quite fossiliferous.[6] These strata are not here exposed in continuous section with any easily recognized reference plane. It was with the intention of ascertaining their position in the shale mass that the writer undertook to follow these beds east and west from the Mottville locality.

For the sake of simplicity the term Mottville member will be used as a provisional designation for the limy crinoidal band and

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[2] N. Y. State Museum Bulletins 63, p. 14, and 82, pp. 42, 43.

From the western boundary of the Skaneateles quadrangle to Cayuga Lake continuous sections are rare, but there is always some reference plane by which to check the position of the Mottville beds. In the same area there are also some slight variations in lithologic character, but these are clearly of a progressive nature, becoming more pronounced by slow degrees from east to west. Paleontologic characters are well maintained throughout the region in question and one more evidence of continuity is afforded by the escarpment which is frequently produced by the harder layers.

The more important sections met with in passing from the Tully quadrangle to Cayuga Lake are shown slightly idealized in Plate XXII.

Section 2 is exposed in a ravine situated west of Cottle Hill and about $\frac{3}{4}$ mile from the western limit of the Skaneateles quadrangle. The harder portions of the Mottville are well displayed at this locality and their position relative to the black Marcellus is beyond all question, for the section is continuous. About $1\frac{1}{8}$ miles southwesterly at nearly the same altitude and on the Auburn quadrangle is found another exposure of the Mottville crinoidal layer and associated shales. Here unfortunately the black Marcellus is not shown below in continuous section. It is exposed, however, at a lower altitude in a near-by ravine within $\frac{1}{4}$ mile to the west. The relation is the same as that shown in section 2. This easternmost Mottville exposure on the Auburn quadrangle is an important one. It can be connected by a nearly continuous escarpment with the Mottville layers of section 2. It agrees in its lithologic and paleontologic characters with other exposures of the Mottville. It lacks only a *continuous* section to prove its stratigraphic position above [redacted]

Criss Creek by Luther whose interpretation of its section seems to be as follows: The hard layer producing the falls near the lake road bridge is "Near the top" of the "Cardiff." A "gray fossiliferous band at the base of the formation" which occurs at the private road crossing farther north is attributed to the horizon of the Stafford limestone of western New York.

The present writer's interpretation of the same section may be summarized in this way: The hard layers making the falls near the lake road bridge are the upper limy portion of the Mottville. They are underlaid by about 15 feet of gray shale rich in small fossils. These latter are the lower soft shales of the Mottville and are considered the equivalent of strata which on the Tully quadrangle have been assigned to the Skaneateles by others. A short distance below the lake road bridge their contact with the underlying black Marcellus is well displayed. The "gray fossiliferous band" exposed near the private road crossing farther down stream is not connected by continuous section with the Mottville at the lake road bridge. It has the same lithologic and paleontologic characters as the lower 15 feet of Mottville at the lake road bridge. It is also immediately overlaid by material indistinguishable from the harder Mottville, while a short distance still farther down stream another exposure of typical Marcellus is found. It is believed that the lakeward dip which is plainly visible in places and a slight folding are responsible for the repetition of the strata.

This latter interpretation is amply confirmed by a study of the lake shore sections east and west of the Lehigh Valley track between Levanna and Farley's. It also appears to be in harmony with the section of the region which was published by Cleland in 1903.[14]

That is (1) a fossiliferous zone is separated from a black shale by a bed of barren gray shale, (2) followed west the fossil zone is seen to approach nearer and nearer to the black shale in successive sections, (3) at the west the fossiliferous zone lies immediately above the black shale.

Such relations at least suggest an unconformity somewhere in the series. The writer has, however, failed to discover positive evidence of one in passing from the Onondaga to the Mottville. It is true that the base of the Mottville limy layer is frequently very uneven. The same observation likewise holds for the Agoniatites limestone. Both cases are, however, regarded as due to a concretionary structure; limy segregations merely pushing downward into the strata below.

When considered in relation to the general black shale problem, it is believed that the data obtained in this area go to strengthen the theories which explain the Marcellus as an invasion from the east and south toward the north and west.[16] On the other hand, transgression over a land surface is somewhat questionable; in fact, the evidence rather points to a different conclusion. We are apparently justified in regarding the Marcellus as a formation which, so to speak, runs diagonally across the geologic column, its lower layers and more eastern portions being contemporary with some Onondaga to the west while its upper and more western portions were probably deposited at a time when Cardiff sedimentation was occurring to the east.

Evidence presented by Kindle[17] shows that black shale (presumably Marcellus) deposition in the Allegheny region was taking place at the same time with Onondaga accumulation. For the particular

The following annual reports were referred to the Publication Committee:

REPORT OF THE RECORDING SECRETARY.

Six meetings were held during the year, with an average attendance of fifty-eight. Communications of interest, as recorded in the PROCEEDINGS, were made at the sessions held February 16, March 16, and April 20.

Twenty-eight papers have been presented for publication, as follows:

Henry W. Fowler, 4; Adele M. Fielde, 2; E. G. Vanatta, 2; H. A. Pilsbry and James H. Ferris, 2; T. Barbour and G. K. Noble, 1; William H. Dall, 1; N. E. McIndoo, 1; H. Matsumoto, 1; James A. G. Rehn, 1; Albert P. Morse and Morgan Hebard, 1; James A. G. Rehn and Morgan Hebard, 1; William Churchill, 1; Stanislas Meunier, 1; Charles P. Alexander, 1; Edgar T. Wherry and S. G. Gordon, 1; John W. Harshberger, 1; S. Stillman Berry, 1; Clarence B. Moore, 1; Phineas W. Whiting, 1; Howard Crawley, 1; Burnett Smith, 1, and Nathan Banks, 1.

Twenty-one of these have been printed, four are awaiting publication, one appeared as a contribution to the JOURNAL, and two were returned to the authors.

Six hundred and sixteen pages of the PROCEEDINGS, illustrated by twenty-five plates, have been printed. The second part of the sixteenth volume of the JOURNAL has also been issued. It consists

Chapter II, Art. 1: Change "the last stated meeting of the month" to "any stated meeting."

Art. 2: Change first sentence to read "Candidates for membership shall be nominated in writing by at least two members, who shall record the name and place of residence. The nominations shall be posted in the Hall of the Academy and read before a meeting of the Council and the candidate shall be balloted for at any subsequent stated meeting, provided that at least two weeks shall have elapsed since their nomination and posting.

Art. 3: Change "fee of initiation" to "first annual contribution."

Art. 4: Change "fee of initiation" to "first annual contribution."

Art. 11: Change "fee of initiation" to "the annual contribution."

Art. 13: Omit "an initiation fee of Ten Dollars and an" and substitute "the" for "an."

Art. 14: Omit "and all initiation fees."

Art. 17: Omit "who has not paid the initiation fee or."

Chapter IV, Art. 1: Omit the word "monthly" in the last sentence and alter "day" to "days," *i.e.*, to read: "days on which the meeting shall be held."

Chapter IX, Art. 3: Change to read "Certain books specified by the Librarian and the Library Committee may be loaned to members for a period of not exceeding one month. A list of such books shall be prepared for the consultation of members and books may be added to it or withdrawn from it at the discretion of the

On the adoption of these amendments a new edition of the By-Laws was printed and distributed.

The usual societies have held meetings in the Academy during the year.

EDWARD J. NOLAN, *Recording Secretary.*

REPORT OF THE CORRESPONDING SECRETARY.

The diminished volume of foreign correspondence and reduced number of international scientific congresses commented upon in the last annual report of the Corresponding Secretary were even more apparent in 1915, inasmuch as the conditions were operative throughout the entire year.

Death collected an unusually heavy toll from the roll of correspondents, including some of the most eminent, as follows: Léon Vaillant, James Geikie, A. A. W. Hubrecht, Richard Lydekker, Frederic W. Putnam, Theodor Boveri, George M. Sternberg, Edw. L. Greene, Orville A. Derby, and H. E. Dresser.

To insure a more systematic and careful examination into the qualifications of proposed candidates for correspondents, a committee of Council on the nomination of correspondents was appointed. Upon the recommendation of this committee the following named were nominated by the Council and elected by the Academy: Alfred C. Haddon, Wilhelm Ludwig Johannsen, William Trelease, Carl Diener, Samuel Wendell Williston, Charles E. Barrois, Thomas Chrowder Chamberlin, Albrecht Penck, William Bateson, and Stanislas Meunier.

The principal invitations received during the year were to the inauguration exercises of Edward Kidder Graham as President of the University of North Carolina, at which Professor H. V. Wilson served as the representative of this Academy; the twenty-fifth anniversary of the founding of The Nebraska Academy of Sciences, Professor George T. Moore being our representative; the commencement exercises of the University of Pittsburgh; the twenty-fifth annual meeting of the Ohio Academy of Science, to which Dr. Howard Ayers went as our delegate; the fiftieth anniversary of the administration of Alexander F. de Waldheim as Director of the Imperial Botanical Garden of Petrograd, which was acknowledged by a letter of congratulation; and to the postponed meeting of the Nineteenth International Congress of Americanists, which is to convene

in Washington this month and to which the Honorable Charles D. Walcott and Miss H. Newell Wardle were last year appointed delegates.

Letters thanking the Academy for courtesies extended during the Convocation Week meetings of 1915 were received from the American Association for the Advancement of Science, the Geological Society of America, and the American Fern Society.

Correspondence with individuals and institutions requesting information on a variety of subjects was conducted as usual.

Statistics of the correspondence transacted is shown in the following table:

Communications received:

Acknowledging receipt of the Academy's publications	160
Transmitting publications to the Academy	57
Requesting exchanges or the supply of deficiencies	1
Invitations to learned gatherings, celebrations, etc	9
Notices of deaths of scientific men	10
Circulars concerning the administration of scientific and educational institutions, etc	29
Photographs and biographies of correspondents	4
Letters from correspondents	13
Miscellaneous letters	100
Total received	383

Communications forwarded:

Acknowledging gifts to the library	1,155
Requesting the supply of deficiencies	124
Acknowledging gifts to the museum	134
Acknowledging photographs and biographies	5
Letters of sympathy or congratulation, addresses, etc	7
Diplomas and notices of election of correspondents and delegates' credentials	17
Miscellaneous letters	180

Exchanges	2,754
I. V. Williamson Fund	1,825
United States Department of Agriculture	532
American Entomological Society	298
General Appropriation	292
J. A. Meigs Fund	136
Authors	91
Editors	77
United States Bureau of Education	62
Pennsylvania Department of Agriculture	33
Queensland Department of Mines, Geological Survey	33
New York Agricultural Experiment Station	31
Imperial Department of Agriculture, British West Indies	30
Dr. Witmer Stone	24
Pennsylvania Department of Health	20
Commission Géologique de Finlande	18
Thos. B. Wilson Fund	15
Dr. Henry Skinner	15
United States Department of the Interior	14
United States Department of Commerce and Labor	14
Pan-American Union	12
American Iron and Steel Institute	12
National Academy of Sciences	10
United States War Department	8
Library of Congress	8
Dr. Edward J. Nolan	8
Department of Trade and Customs, Australia	8
Sveriges Geologiska Undersökning	8
New Mexico College of Agriculture	7
Florida State Geological Survey	7
Topographic and Geologic Survey of Pennsylvania	7
Department of Fisheries, Bengal, Bihar and Orissa	7
Geological Survey of New Jersey	6
California Fish and Game Commission	6
Pennsylvania State Library	6
Illinois State Geological Survey	5
Estacion Seismologica de Cartuja	5
Argentine Government	5
Commission of Conservation, Canada	4
William J. Fox	4
Seismological Society of America	4
Indiana University	4

Publication Committee of the Academy	4
Wisconsin Geological and Natural History Survey	4
Pennsylvania Water Supply Commission	3
Lowell Observatory	3
Japan Society of America	3
University of Tennessee	3
Michigan Geological and Biological Survey	3
Ella B. Altemus	3
Central Seismological Station in Pulkow	3
Bentham Trustees, Kew Gardens	2
University of Wyoming	2
Rockefeller Sanitary Institute for the Eradication of the Hook Worm	2
American Institute of Electrical Engineers	2
State Board of Charities, New York	2
Government of India	2
Washington Geological Survey	2
Wistar Institute of Anatomy	2
Pennsylvania Department of Forestry	2
Pennsylvania State College	2
Hervas Laboratory of American Linguistics	2
Observatorio Astronomico de Madrid	2
Dr. W. D. Bayley	2
Goodsell Observatory	2
Clarence B. Moore	2
Editors of Entomological News	1
Museum d'Histoire Naturelle de Havre	1
Dr. Thomas Biddle	1
James F. Wood	1
Pennsylvania Chestnut Tree Blight Commission	1
Warren Academy of Sciences	1
Iowa Geological Survey	1
Charles H. Townsend	1
Gouvernements Kina Onderneming te Tjinjiroean (Bandoeng)	1
Government of Formosa	1
Colorado Museum of Natural History	1
Geological Survey of Alabama	1
Connecticut Geological and Natural History Survey	1
United States Brewers' Association	1
Delaware Valley Ornithological Club	1
Los Angeles County Museum of History, etc	1

Zoological Society of Philadelphia	1
Dr. William H. Dall	1
Trustees of Estate of Lucy Hunter Baird	1
Geological Survey of Georgia	1
Imperial Institute for the Study of Infectious Diseases, Tokyo	1
Dr. Ulric Dahlgren	1
Cuerpo de Engenieros de Minas del Peru	1
Commissao de Linhas Telegraphicas Estrategicas de Matto Grosso	1
Pennsylvania Department of Fisheries	1
Joseph Willcox	1
Charles W. Richmond	1
Nora C. Fretageot	1
Commissioners on Fisheries and Game, Massachusetts	1
Hirase Conchological Museum	1
Crosby Frisian Fur Company	1
Delaware County Institute of Science	1
Albert I, Prince de Monaco	1
Game Commissioners of Pennsylvania	1
Dr. Charles K. Mills	1
Philadelphia Museums	1
Japanese Commission to the Panama-Pacific International Exposition	1

They have been distributed to the several departments of the Library as follows:

Journals	4,593
Agriculture	657
Geology	517
Botany	139
Entomology	102
Geography	102
General Natural History	90
Anatomy and Physiology	60
Voyages and Travels	44
Ornithology	30
Conchology	23
Medicine	22
Bibliography	19
Helminthology	17
Anthropology	17
Physical Sciences	16
Mineralogy	12
Ichthyology	11
Herpetology	9
Mathematics	9
Chemistry	8
Mammalogy	8
Dictionaries	2
Philology	1
Miscellaneous (unclassified)	53

The following are perhaps worthy of special mention:

Bergsträsser, Nomenclatur und Beschreibungen der Insekten, etc., 4 parts in 2 vols., 1778–1780.

Howard, British Warblers.

Beccari, Palmen de Madagascar, 1914.

Cybele Columbiana, Washington, I, 1.
Discovery, Philadelphia, I, 1.
Gouvernements Kina-Onderneming te Tjinjiroean (Bandoeng), Batavia, 1913.
Hawaiian Forester and Agriculturist, Honolulu, partial set of I–XII.
Hervas Laboratory of American Linguistics, Bulletin, St. Louis, Nos. 4, 5.
Illinois Biological Monographs, Urbana, I, 1–4.
Instituto di Geografia, etc., Catania, Nos. 1–4.
Jugoslavenska Akademija Znanosti i Umjetnosti, Isvjescao Rospravama Matem.-Prir. Razreda, No. 2; Prirodoslova Istrazivanja, etc., Matem.-Prir. Razreda, Nos. 1–3.
Los Angeles County Museum of History, etc., Miscellaneous Publication, No. 1.
Missouri Botanical Garden, Annals, I; II, 1–3.
Mycological Bulletin, Columbus, imperfect set.
National Academy of Sciences, Washington, Proceedings, I, 1–11.
Natur und Heimat, Godesberg, Nos. 1–9.
Ohio Naturalist, Columbus, complete.
Pennsylvania Department of Forestry, Harrisburg, Bulletin Nos. 11, 12.
Philippine Agricultural Review, Manila, V; VI; VIII, 1.
Phytopathology, Baltimore, V, 1–5.
Progrès Agricole et Viticole, Villefranche, XXXII–XXXVI.
Queensland Department of Mines (Geological Survey, Brisbane, Annual Report, 1901–1914; Publications, part of 119–239.
Regensburgische Botanische Gesellschaft, Regensburg, Schriften I, 1792.
Scientific Monthly, New York, I, 1–3.
Société d'Études Scientifiques de l'Aude, Carcassone, Bulletin, I–VII, XI–XXIV.
Société des Lettres, Sciences et Arts de Bar-le-Duc et Commercy, Bar-le-Duc, Bulletin Mensuel, 1913.
University of Chicago, Bulletin of the Department of Anthropology, Nos. 1–5.
Vorträge aus dem Gesamtgebiet d. Botanik, Berlin, 1.
Walker Museum, Contributions, Chicago, I, 1–8.
Zoologische Mededeelingen, Leiden, Afl. 1.

A well-bound copy of the Rev. J. G. Wood's *Animate Creation*, in three volumes, quarto, has been given to the Academy by Miss Ella B. Altemus, in memory of the late William Wilkinson Altemus.

The notable decrease in the number of additions to the Library during 1915 has been due to two causes: A lessening of appropriations, but more especially the interference with foreign correspondence by the horrible war which is, in one way or another, affecting every human interest, most of them disastrously. The German production of scientific publications was at first sustained, but is now decreasing. Out of sixty-nine German periodicals subscribed for nothing has been received from twenty-one of them. The English journals continue as usual, and the French, while much affected at first, are now for the most part going on as before the war. We have been warned by the Royal Academy of the Lincei, the Royal Academy of Sciences of Petrograd, and the Chemical Society of London that issues forwarded now must be at our risk, as losses, if any occur, will not be made up. In these cases it has been thought best to ask for a prompt supply of publications, assuming such risk as may be involved, for it will probably not be more than we should run in expecting the volumes in bulk at the end of the conflict.

Shipments from Germany and Austria were stopped by a British Order in Council in June. We are informed, however, that the British Government is now prepared to issue permits for shipment of scientific books to the United States from Germany and Austria if destined for universities, colleges, scientific societies or public bodies. We may profit during the coming year by this relaxation, although it is accompanied by a great deal of annoying red tape.

The interruption of exchange noted in the report of the Recording Secretary of course greatly affects the receipts from corresponding societies. Even when regular shipments are made invoices and bills of lading are held up on the other side and insufficient steamer accommodations cause uncertain deliveries.

Chapter IX, Art. 3, of the By-Laws was amended in January so as to permit of the loaning to members of certain books specified by the Librarian and the Library Committee for a period not exceeding one month.

Although it was held by Maclure and his contemporaries that all books belonging to the Academy should be exclusively for use within the building, both for the good of those working on the premises and to lessen the danger of loss, it was considered that such a rule was not practicable until the services of a Librarian during portions of the day could be secured. Certain designated books were therefore permitted to be borrowed until 1850, when Thomas B. Wilson presented to the Academy the extremely valuable works which he had from time to time deposited with the understanding that they should never be loaned on any condition. This applied to such an important portion of the Library that the rule was then made general and from 1850 until last January no books were knowingly

direction of the Council, no volumes or parts of journals or periodicals may be borrowed without the special consent of the Librarian, who must be reasonably sure, before the publication is sent out, that the interests of those working on the premises will not be interfered with by the loan.

As required by the By-Law, a separate list of books that can be borrowed is being prepared and is nearing completion.

A very desirable subject index to the map collection has been prepared by Mr. Fox.

Forty-seven volumes of works not connected with the Academy's interests have been transferred to the Free Library of Philadelphia.

A framed photograph of Rembrandt Peale's oil portrait of Reuben Haines, who served most efficiently as Corresponding Secretary from February, 1814, to December, 1831, has been presented by his grandson, Reuben Haines.

A framed photograph from life of the late Dr. Benjamin Sharp has been received from Mrs. Sharp.

Through the liberality of a number of subscribers, there has been obtained a replica of the portrait of Baron Von Humboldt, painted from life in 1856 by J. R. Lambdin, and now in the rooms of the American Philosophical Society. The picture has been beautifully framed by the President of the Academy.

It is pleasant to again acknowledge the good work done by William J. Fox and Furman Sheppard Wilde, both in the Library and in connection with the issue of the publications.

EDWARD J. NOLAN, *Librarian.*

REPORT OF THE CURATORS.

The completion of the year 1915 finds the Academy's buildings and collections in excellent condition. Much important work has been accomplished in studying, arranging, and cataloguing material in the several departments of the Museum, and many important accessions have been received through gift or purchase.

The number of visitors to the Museum has steadily increased, especially classes from the schools of Philadelphia and vicinity which come to study the exhibits under the guidance of their teachers.

At the last session of the State Legislature the sum of $10,000 was appropriated to the Academy for the purchase of cases, and arrangements have been made to furnish the north wing of the Museum with exhibition cases so that it may be reopened to the public during

the ensuing year, and to provide much needed exhibition and storage cases in the various departments.

During the past year the Curators have purchased three large mahogany and plate-glass exhibition cases, one for a group of buffalo and two for the collection of wood of native forest trees. Two horizontal oak cases have also been procured for the William S. Vaux archæological collection, as well as eighteen metal storage cases, 450 trays and 100 insect boxes.

Mr. Clarence B. Moore continued his explorations among the Indian mounds of the Southern States, the results of which have been generously added to the Clarence B. Moore Collection.

A valuable collection of Antarctic material obtained on Sir Ernest Shackleton's expedition was presented by Mr. John H. McFadden. The framed photographs of scenery and animals have been placed on exhibition in the lower hallways and the other specimens arranged in the several departments.

Leave of absence was granted to several members of the Museum staff for the prosecution of field work. Through the liberality of Mr. Morgan Hebard, Mr. J. A. G. Rehn was enabled to accompany him on a two months' trip through the Gulf States from northern Florida to eastern Texas, for the purpose of studying the Orthoptera of the region, one-half of the material obtained becoming the property of the Academy.

Dr. Henry A. Pilsbry spent the greater part of August and September in an exploration of the Black Range of New Mexico, obtaining large series of land mollusks, part of them new to science, as well as collections of reptiles and plants.

Mr. Stewardson Brown accompanied Dr. and Mrs. N. L. Britton

been articulated and mounted in the centres of the geological and mineralogical halls and attract much attention. This work was done by the Academy's taxidermist, Mr. David McCadden, assisted by Mr. E. W. Stucke.

The collection of skins of the larger mammals was carefully gone over during the year and systematically arranged by Dr. Witmer Stone, while the entire osteological collection was systematized and labelled by Mr. Earl L. Poole, a student on the Jessup Fund. This collection is now readily accessible and its usefulness vastly increased.

Twenty-six mammals have been received from the Zoological Society of Philadelphia during the year, which have been variously prepared by the taxidermist as skins or osteological material.

A set of the McGregor restorations of Pithecanthropus and other early anthropoid and human types was presented by Dr. Samuel G. Dixon.

Numerous students have made use of the collections during the year and specimens have been loaned to Drs. J. A. Allen and C. Hart Merriam, Messrs. W. H. Osgood and H. W. Henshaw.

Birds.

The rearrangement and renovation of the study series of birds have progressed satisfactorily during the year and only five families of the Passeres and the Steganopodes still demand attention. Mr. D. E. Culver, student on the Jessup Fund, has relaxed the old unmounted specimens and remade many of the skins, while Dr. Witmer Stone has systematically arranged and labelled the groups as they were completed. He has also entirely rearranged the local study series of land birds, bringing all of the local material together for the first time.

A number of specimens have been identified for the Zoological Society and for correspondents.

Mr. Samuel N. Rhoads, accompanied by Mr. Earl L. Poole, undertook an expedition to Guatemala, from February to April, in the interests of the Academy, the expenses being met partly by the Academy and partly by Mrs. Beulah M. Rhoads and William P. Elkinton.

A fine series of about 700 birds, a number of mammals and some specimens in other branches were obtained.

Besides this material an additional series of birds from Santa Marta, Colombia, was purchased, as well as a series of Petrels from South Georgia Island.

The Delaware Valley Ornithological Club has added a number of rare and valuable specimens to the local collection and other local material was received from various sources.

Six metal-covered storage cases were substituted for the old wooden cases formerly used for the larger birds and the specimens arranged to much better advantage. By the end of next year it is expected that the entire collection of skins will be accommodated in metal cases.

Mr. James P. Chapin spent two days studying the Academy's type series of West African birds and Mr. Rhoads has spent considerable time in the department preparing a report on his Guatemala collection.

Many local students have made use of the study collection and specimens have been loaned to Drs. F. M. Chapman, C. W. Richmond, Messrs. R. Ridgway, W. E. C. Todd, C. B. Cory, H. K. Coale and R. C. Murphy.

Reptiles and Batrachians.

This department has, as in 1914, been under the charge of Mr. Henry W. Fowler. All accessions have been identified and cared for, 153 having been tagged, catalogued and distributed. The entire series of Salamanders has been critically studied and rearranged and a collection of reptiles and batrachians from Porto Rica has been identified for Princeton University, in return for which service the Academy received a fine series of duplicates. Mr. E. R. Dunn has spent much time studying the collections in this department and Dr. Thomas Barbour spent two days examining some of the types. Several specimens were loaned to Dr. Barbour.

from Washington and Oregon, received from Mr. John A. Allen; Antarctic shells of the Sir Ernest Shackleton Expedition, from Mr. John H. McFadden, and Mexican shells from C. R. Orcutt. Messrs. Clarence B. Moore, Morgan Hebard, S. S. Berry and others have made many gifts of southern and western shells, and Mr. Bayard Long has continued his collections in New Jersey.

The John Ford collection of *Olividæ*, purchased during the year, when added to that of the Academy, forms probably the most extensive series of these shells in any museum.

With Mr. James H. Ferriss, the special curator spent the greater part of August and September in an exploration of the Black Range of New Mexico, obtaining large series of land mollusks, part of them new to science.

We have also been favored with a complete series of the mollusks taken by Messrs. Junius Henderson and D. E. Daniels, who collected in many localities from Provo, Utah, to Franklin in southern Idaho.

The study of Hawaiian material of the expedition of 1913 has been continued throughout the year. The family *Tornatellinidæ* has been completed, and a monograph published in the MANUAL OF CONCHOLOGY, Volume XXIII. The proportion of undescribed forms proved to be unusually large, the volume containing descriptions of 103 new species and 29 new subspecies. Dr. C. Montague Cooke, of the Bishop Museum, Honolulu, collaborated with the special curator in this work.

Mr. E. G. Vanatta, assistant in the department, has been chiefly occupied in the determination and labelling of specimens received. Miss Caroline Ziegler has continued the work of cataloguing the collection.

The Wheatley collection of fresh-water shells has been deposited by the University of Pennsylvania, and some progress has been made in cleaning, labelling and cataloguing the specimens.

During the year the collections have been studied by Messrs. George H. Clapp, Frank M. Anderson, Drs. W. H. Dall and A. Olssen, while material has been loaned to Drs. W. H. Dall and Paul Bartsch, Messrs. Junius Henderson and J. B. Henderson.

INSECTS.

Dr. Henry Skinner, head of the department of Insects, reports that much of his time and that of Mr. E. T. Cresson, Jr., has been devoted to relaxing and mounting the new material acquired. Portions of the collection have also been rearranged in the new cases procured during the year.

In the order Diptera the families Tipulidæ and Dolichopodidæ have been rearranged.

In the Coleoptera the labelling of the Horn types has been continued and the rearrangement of the family Scarabæidæ completed.

In the Hymenoptera, the rearrangement of the Ophionini and Pimplinæ has been finished.

In the Lepidoptera, the Welles collection was safely transported from Elwyn, Pa., and the following families rearranged: Agrotinæ, Syntomidæ, Saturnidæ, Lycænidæ, and the exotic Nymphalidæ and part of the Pieridæ. The genera Kallima, Papaipema and Autographa were also rearranged.

In the Orthoptera the series of the genera Orchelimum, Conocephalus and Atlanticus have been rearranged in the new type of double box, which was all the general rearrangement possible during the year with the few boxes available.

Mr. J. A. G. Rehn spent two months in the field in company with Mr. Morgan Hebard, working in the Gulf States from northern Florida to eastern Texas. The trip, which was highly successful, resulted in securing a very large series from the most neglected portion of the eastern States, of which collection the Academy will receive one-half.

Mr. Hebard has continued his studies, based very largely on the material in his own collection, here deposited, and in the Academy series. He has also continued to maintain a preparator, whose services as in the past have been given very liberally to the Academy. By his aid it was possible to have mounted practically all the previously unmounted Orthoptera owned by the Academy. In collaboration with Mr. Hebard, Mr. Rehn has completed the final

tions, including Messrs. A. F. Satterthwait, A. P. Morse, E. Daecke, C. W. Long, W. T. Davis, J. C. Bradley, Charles Schaeffer, J. C. Crawford, S. A. Rohwer, A. B. Gahen, R. A. Cushman, A. N. Caudell, and A. Avinoff.

Material has been loaned to Dr. E. M. Walker.

Other Invertebrates.

Mr. H. W. Fowler has looked after the alcoholic material and arranged numerous small local collections of spiders, crustacea, etc. Mr. J. H. Emerton has studied the series of spiders during the year. Specimens of annelids have been loaned to Dr. C. A. Kofoid, and J. F. Daniel.

Invertebrate Fossils.

Dr. A. P. Brown has spent considerable time at the Academy during the summer months studying the collections in this department and in conjunction with Dr. Pilsbry has prepared a report on the Oligocene fossils obtained by Mr. Lloyd B. Smith in Colombia.

Drs. A. Olsen and L. W. Stephenson have spent some time studying the collections, and material has been loaned to F. W. Stanton and T. Wayland Vaughan.

Vertebrate Fossils.

The large slabs of fossil footprints together with certain geological specimens have been arranged on the wall spaces between the windows in the mineralogical hall.

Material was loaned during the year to Drs. O. P. Hay and J. C. Merriam, and in return for the courtesy Dr. Merriam presented the Academy with a specimen of Smilodon from the asphalt deposits of the Rancho La Brea, California.

Herbarium.

Mr. Stewardson Brown's continued illness has again kept him from his duties in charge of the Herbarium for about half of the past year, while for several months he was absent with Dr. N. L. Britton on a collecting trip to Porto Rico.

During his absence the Academy has again been dependent upon the voluntary services of Messrs. Bayard Long and S. S. Van Pelt, who have generously looked after the general herbarium in addition to their continued care and development of the local herbarium in which they have interested themselves for a number of years.

Work has necessarily been mainly confined to caring for the accessions. Miss Ada Allen has continued with the mounting of the specimens and has prepared for cataloguing and distribution 3,150 sheets. Mr. Van Pelt has mounted all accessions to the local collection, amounting to 3,114 sheets and including 664 from the Porter herbarium, which have been distinctively labelled in accordance with the agreement with Lafayette College, by which institution they were deposited.

Mr. Long has distributed and identified material added to the local herbarium and made critical studies of various groups. He has also attended to much correspondence in connection with the general collection.

The herbarium has been consulted during the year by Dr. C. S. Sargent, W. W. Eggleston, Harold St. John, Francis Pennell and many others, and specimens have been loaned to W. W. Eggleston, P. C. Standley, Dr. R. H. Howe, Dr. J. C. Arthur, K. K. McKenzie, B. H. Smith, Dr. C. S. Sargent, Dr. F. Pennell, Harold St. John, Dr. J. M. Greenman, Prof. M. L. Fernald.

The collection of trunk sections of native trees of the Alleghanies presented by Mr. C. H. Jennings has been prepared for exhibition and placed in two mahogany and plate-glass cases in the mineralogical hall just outside the entrance to the herbarium, where it attracts much attention.

Minerals and Rocks.

Mr. S. G. Gordon, under the direction of Mr. Frank J. Keeley, Curator of the William S. Vaux Collections, has completed a check list of minerals according to the sixth edition of Dana's *Manual*

ARCHÆOLOGY AND ETHNOLOGY.

Mr. Clarence B. Moore has placed on exhibition in this department the material obtained on his expeditions during the year.

Two additional exhibition cases were obtained by the William S. Vaux Fund for the display of the European archæological material in that collection, chiefly from Scandinavia and Switzerland.

Miss H. N. Wardle has cared for the collections during the year and rearranged portions of the display, preparing a number of new labels.

Besides the material in the Vaux collection, the specimens in the Gottschall collection from the Frazer and Thompson Rivers, B. C., and from Washington, Oregon, Montana, and the Shasta tribes of California, have been catalogued and displayed.

A rearrangement of some of the cases has added much-needed floor space and given uniformity of aspect.

CURATORS { WITMER STONE, *Chairman.*
SAMUEL G. DIXON.
HENRY A. PILSBRY.
HENRY TUCKER.

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTIONS.

During past year new cases have been purchased and installed, under the supervision of the Curators of the Academy, for the display of the archæological collection.

There have been few accessions to the mineral collection, as it has been considered advisable to defer any extensive purchases until the completion of the contemplated rearrangement.

Respectfully submitted,

F. J. KEELEY, *Curator Wm. S. Vaux Collection.*

REPORTS OF THE SECTIONS.

BIOLOGICAL AND MICROSCOPICAL SECTION.—The Section has held seven stated meetings during the year, with the usual attendance.

A serious loss to our membership is the death of Dr. Benjamin Sharp, whose coöperation for many years is remembered gratefully. Suitable resolutions have been spread upon the Minutes.

Communications on the favorite subjects of investigation by different members have been numerous. Among those contributing

are the following: J. Cheston Morris, T. Chalkley Palmer, Frank J. Keeley, Thomas S. Stewart, Hugo Bilgram, and Charles S. Boyer.

At the annual election of officers, the following were chosen for the year 1916:

Director	J. Cheston Morris,
Vice-Director	T. Chalkley Palmer.
Recorder	Charles S. Boyer.
Treasurer	Thomas S. Stewart,
Conservator	Frank J. Keeley.
Corresponding Secretary	Silas L. Schumo.

CHARLES S. BOYER, *Recorder.*

ENTOMOLOGICAL SECTION.—The meetings of the Section have been well attended during the year and the communications made have been published. A large amount of valuable material has been added to the collection. Two members and a contributor have been elected. At a meeting held December 13 the following officers were elected to serve for the ensuing year:

Director	Philip Laurent.
Vice-Director	R. C. Williams.
Treasurer	Ezra T. Cresson.
Secretary	J. A. G. Rehn.
Recorder	E. T. Cresson, Jr.
Publication Committee	E. T. Cresson,
	Philip P. Calvert,
	E. T. Cresson, Jr.

A detailed list of accessions to the herbarium will be found in the Additions to the Museum.

The Conservator wishes to record his appreciation of the valuable assistance rendered, during his absence through illness, by Mr. Bayard Long in caring for certain details of the work of the herbarium.

Miss Ada Allen has continued her services during the year as aid in the herbarium.

The American Fern Society held its meeting in the herbarium of the Academy, December 28 and 29. On the evening of December 31 the Section gave a reception and smoker to the botanists attending the meetings of the American Association for the Advancement of Science, when we had the pleasure of welcoming more than 200 visitors in the herbarium. The occasion afforded many their first opportunity of examining the collections.

The following officers of the Section have been elected for the ensuing year:

Director........................Benjamin H. Smith.
Vice-Director........................Joseph Crawford.
Recorder........................John W. Eckfeldt, M.D.
Treasurer and Conservator........................Stewardson Brown.

Respectfully submitted,

STEWARDSON BROWN, *Conservator.*

MINERALOGICAL AND GEOLOGICAL SECTION.—The Section held four meetings, with about the usual average attendance.

Communications were made by Thomas C. Brown, on the Geology and Fossil Corals of Jefferson County, Kentucky, and on the Shawangunk and Green Pond Conglomerate; and by F. Lynwood Garrison, on Alluvial Gold Deposits in Alaska and elsewhere. Other subjects of geological or mineralogical interest were discussed.

There were three field excursions, with an average attendance of seventeen. The parties visited: (1) The crystalline rocks and their minerals between Avondale and Morgan Station, Delaware County; (2) the New Red Norristown Shales and No. 11 Limestone in Buckingham Township, Bucks County; (3) the gneiss and its minerals near Crum Creek, Delaware County.

The following officers of the Section have been elected for the year 1916:

Director	Benjamin Smith Lyman.
Vice-Director	F. J. Keeley.
Recorder and Secretary	S. L. Schumo.
Treasurer	William B. Davis.
Conservator	George Vaux, Jr.

Respectfully submitted by order of the Section,

BENJ. SMITH LYMAN, *Director.*

ORNITHOLOGICAL SECTION.—The Section has maintained an active interest in the ornithological department of the Academy and in furthering study in this branch of science.

The Pennsylvania Audubon Society and Delaware Valley Ornithological Club have been encouraged to hold their meetings at the Academy and in this way many persons interested in bird study have come into closer relation with the society, resulting in important additions to the collection and in the acquisition of important data.

At the annual meeting of the Section the following officers were elected for the ensuing year:

Director	Spencer Trotter.
Vice-Director	George Spencer Morris.
Recorder	Stewardson Brown.
Secretary	William A. Shryock.
Treasurer and Conservator	Witmer Stone.

Respectfully submitted,

WITMER STONE, *Conservator.*

The annual election of Officers, Councillors, and Members of the

COUNCILLORS TO SERVE THREE YEARS	Philip P. Calvert, Ph.D.,
	Frank J. Keeley,
	Walter Horstmann,
	William Pepper, M.D.
COMMITTEE ON ACCOUNTS	Charles Morris,
	Samuel N. Rhoads,
	John G. Rothermel,
	Thomas S. Stewart, M.D.,
	Walter Horstmann.

COUNCIL FOR 1916.

Ex-Officio.—Samuel G. Dixon, M.D., LL.D., Edwin G. Conklin, Ph.D., John Cadwalader, A.M., Edward J. Nolan, M.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D.

To serve three years.—Philip P. Calvert, Ph.D., Frank J. Keeley, Walter Horstmann, William Pepper, M.D.

To serve two years.—Charles B. Penrose, M.D., LL.D., Ph.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.

To serve one year.—Edwin S. Dixon, Henry Skinner, M.D., Sc.D., Robert G. LeConte, M.D., George Spencer Morris.

COUNCILLOR	George Vaux, Jr.
CURATOR OF MOLLUSCA	Henry A. Pilsbry, Sc.D.
CURATOR OF WILLIAM S. VAUX COLLECTIONS	Frank J. Keeley.
CUSTODIAN OF ISAAC LEA COLLECTION	Joseph Willcox.
ASSISTANT LIBRARIAN	William J. Fox.
ASSISTANTS TO CURATORS	Henry Skinner, M.D., Sc.D.,
	Stewardson Brown,
	J. Percy Moore, Ph.D.,
	Edward G. Vanatta,
	Henry W. Fowler,
	James A. G. Rehn,
	Ezra T. Cresson, Jr.
ASSISTANT IN LIBRARY	Furman Sheppard Wilde.
AID IN ARCHÆOLOGY	Harriet Newell Wardle.
AID IN HERBARIUM	Ada Allen.
Taxidermist	David M. McCadden.

Janitors..........Charles Clappier,
Daniel Heckler,
James Tague,
Jacob Aebley,
Adam E. Heckler.

STANDING COMMITTEES, 1916.

FINANCE.—John Cadwalader, A.M., Edwin S. Dixon, Effingham B. Morris, Walter Horstmann, and the Treasurer.

PUBLICATIONS.—Henry Skinner, M.D., Sc.D., Witmer Stone, Sc.D., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D.

LIBRARY.—Henry Tucker, M.D., George Vaux, Jr., Frank J. Keeley, Thomas Biddle, M.D., Witmer Stone, Sc.D.

INSTRUCTION AND LECTURES.—Henry A. Pilsbry, Sc.D., Charles Morris, Henry Tucker, M.D., George Spencer Morris, and Stewardson Brown.

ELECTIONS IN 1915.

MEMBERS.

January 19.—Heber Wilkinson Youngken, Ph.D., George B. Benners.
February 16.—Joseph C. Guernsey, M.D.
March 16.—Jacob Parsons Schaeffer, M.D.

CORRESPONDENTS.

November 16.—Alfred C. Haddon, M.D., of Cambridge, England.
Wilhelm Ludwig Johannsen, M.D., of Copenhagen.

ADDITIONS TO THE MUSEUM, 1915.

MAMMALS.

CUGLEY & MULLIN. Capuchin Monkey (*Cebus* sp.).

SAMUEL G. DIXON, M.D. Restorations of skulls and heads of *Pithecanthropus*, the Neanderthal and Piltdown men.

FREE MUSEUM OF SCIENCE AND ART OF THE UNIVERSITY OF PENNSYLVANIA. Pair of Lesser Kudu (*Ammelaphus imberbis*) horns, pig tusk, rhinoceros tail and worked antler.

H. W. FOWLER. Skeleton of Dolphin (*Delphinus delphis*), Riverton, N. J.

CHARLES GROVES. Moose (*Alces americanus*), Ontario. Young. Skin.

GUY KING. Female Opossum (*Didelphis virginianus*) with young in pouch.

BAYARD LONG. Jumping Mouse (*Zapus hudsonicus*), Spray Beach, N. J.

THOMAS MARTINDALE. Skin and skull of female Alaskan Brown Bear (*Ursus kidderi*?), Cook Inlet, Alaska.

W. E. MEEHAN (PHILADELPHIA AQUARIUM). California Sea-lion (*Zalophus californianus*).

MRS. CURWEN STODDART, JR. Collection of eight mounted heads and horns of game mammals.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Mounted: Rufous Rat Kangaroo (*Æpyprymnus rufescens*). Prepared as skin and skeleton: Siberian Tiger (*Felis tigris mongolica*); Jaguar (*Felis onca*); Philippine Spotted Deer (*Rusa alfredi*); Saddle-backed Tapir (*Tapirus indicus*); Sooty Agouti (*Dasyprocta nigra*). Prepared as skin and skull: Celebean Macaque (*Magus ochreatus*); Geoffroy's Spider Monkey (*Ateles geoffroyi*); Red Ruffed Lemur (*Lemur varius ruber*); Galago (*Galago* sp.); Serval (*Felis serval*); four Northwestern Pine Martens (*Mustela caurina*); American Otter (*Lutra canadensis*); Rusty-spotted Genet (*Genetta rubiginosa*); Leche Waterbuck (*Onotragus lechee*); Alleghany Cave Rat (*Neotoma pennsylvanica*). Prepared as skins: Mahol's Galago (*Galago maholi*); Golden Cat (*Felis temmincki*); Chaus Cat (*Felis chaus*), female and two young; California Sea-lion (*Zalophus californianus*); South African Hedgehog (*Erinaceus frontalis*); young Northern Warthog (*Macrocephalus africanus*). Prepared as skeleton: Mountain Zebra (*Equus zebra*); young male Mearn's Deer (*Odocoileus texana*); white-tailed gnu (*Connochœtes gnu*). Prepared as skull: Sooty Mangabey (*Cercocebus fuliginosus*); Black Lemur (*Lemur macaco*); Galago (*Galago* sp.); South African Hedgehog (*Erinaceus frontalis*).

BIRDS.

W. M. ALDRICH. Collection of hummingbirds, birds' nests and eggs.

DELAWARE VALLEY ORNITHOLOGICAL CLUB. Four nests of Pennsylvania birds.

SAMUEL G. DIXON, M.D. Egg of Cardinal (*Cardinalis cardinalis*).

FREE MUSEUM OF SCIENCE AND ART OF UNIVERSITY OF PENNSYLVANIA. Bird of Paradise (*Paradisea apoda*).

W. W. Justice. Collection of Eggs of Pennsylvania and New Jersey birds comprising 76 sets.

John H. McFadden. Series of mounted Antarctic marine birds and eggs; Sir Ernest Shackleton's Collection.

D. C. McKee. Virginia Rail (*Rallus virginianus*), Philadelphia.

S. W. Morton, M.D. Mounted specimen of Mynah (*Gracula intermedia*.

Purchased. Collection of 176 Colombian birds, 16 petrels, S. Georgia Island, and 700 birds from Guatemala.

S. N. Rhoads. Skins of male Cape May Warbler (*Dendroica tigrina*) and young Starling (*Sturnus vulgaris*), Haddonfield, N. J.

W. Hinckle Smith. Black-crowned Night Heron (*Nycticorax nycticorax nævius*), Bryn Mawr, Pa.

C. Frank S. Stead. Skin of Red-tailed Hawk (*Buteo borealis*), Pennsylvania.

Mrs. Curwen Stoddart, Jr. Three mounted owls.

H. R. Wharton, M.D. Skin of American Merganser (*Mergus americanus*), Salem, N. J.

Robert Willets. American Coot (*Fulica americana*), Barrel Island, N. J.

Zoological Society of Philadelphia. Prepared as skins: Black-footed Penguin (*Spheniscus dimersus*); young Swan (*Olor* sp.); Falcated Seal (*Eunetta falcata*); Victoria Crowned Pigeon (*Goura victoriæ*); Audubon's Caracara (*Polyborus cheriway*); Yellow-billed Hornbill (*Lophoceros leucomelas*); Blue-bellied Lorikeet (*Trichoglossus rubritorques*); Nepaul Parakeet (*Palæornis nepaulensis*); Blue-winged Green Bulbul (*Chloropsis hardwickii*).

Reptiles and Amphibians.

Philip Laurent. Small series of Salamanders, Chestnut Hill, Philadelphia.

P. Lorrilliere. Tree-toad (*Hyla vittata*), Georgetown, Md.

John H. McFadden. One lizard; Sir Ernest Shackleton's Collection.

J. Percy Moore, Ph.D. Type of *Leurognathus marmoratus* Moore, Roan Mountain, N. C.

Museum of Comparative Zoology (in exchange). *Anolis bimaculatus*, *A. luteosignifer*, *Amieva aquilina* Garman (paratype) and *A. atrigularis* Garman (paratype).

Geo. H. Clapp. Eighteen trays of land shells from the Southern States.

T. D. A. Cockerell. Land shells from New Mexico and Coronado Island. Lower Cal.

M. Connolly. Nine trays of land shells from South Africa.

Delos E. Culver. Three shells from New Jersey and Pennsylvania.

Miss E. Cummings. *Praticolella* from Texas.

L. E. Daniels. Forty lots of land shells from Utah.

J. H. Ferriss. Seventy trays of land shells from Arizona and New Mexico.

John Ford Collection. Two hundred and fifty-three trays of *Oliva* (purchased).

H. W. Fowler. Six species of shells from New Jersey and Virginia.

Free Museum of Science and Art. Sixty-three species of Marine shells.

L. S. Frierson. *Ptychobranchus clintonensis* Simps. from Arkansas.

L. P. Gratacap. Three species of land shells from Brazil.

D. K. Greger. Seven land shells from Oklahoma.

S. G. Gordon. Four species of land shells from Montgomery County, Pa.

Seitaro Goto. Two trays of *Blanfordia* from Japan.

Morgan Hebard. Eleven trays of shells from Florida.

Charles Hedley. Six species of shells from Macquarie Island.

J. B. Henderson, Jr. Fourteen trays of shells from Cuba, Bahamas and Virginia.

Junius Henderson. Twenty-two trays of land and fresh-water shells from Utah and Colorado.

H. W. Henshaw. *Amastra flavescens* Nc. from Olaa, Hawaiian Islands.

A. B. Howell. *Micrarionta intercisa* Binn. from San Clemente Island, Cal.

C. W. Johnson. Ten trays of *Oliva* from Japan.

F. W. Kelsey. Nine species of shells from California.

Bayard Long. One hundred and forty-nine trays of shells from Ontario, New Jersey and Pennsylvania.

A. L. Lovett. Four slugs from Oregon.

H. N. Lowe. Fifteen trays of shells from California and Mexico.

C. J. Maynard. Thirty-nine species of *Cerion* from the Bahama Islands, (purchased).

W. G. Mazÿck. Four species of *Nassa*.

H. A. PILSBRY, D.Sc. Five hundred and ten trays of shells chiefly from the Hawaiian Islands.

EARL L. POOLE. *Helicina amœna* Pfr. from Quirigua, Guatemala.

H. W. PRETZ. *Lymnæa obrussa* Say near Corning, Pa.

C. T. RAMSDEN. Three Cuban land shells.

MRS. F. W. RAWLE. One marine shell from Maine.

S. N. RHOADS. Six species of land shells from New Jersey.

S. RAYMOND ROBERTS. Nineteen species of shells from Australia and West Indies.

S. L. SCHUMO. *Vitrea hammonis* Ström from Glenwood Springs, Colo.

B. SHIMEK. *Pisidium virginicum* Gmel. from near Iowa City, Ia.

LLOYD B. SMITH. Twenty-seven trays of shells from Columbia.

G. C. SPENCE. Twelve trays of shells from England.

V. STERKI. Two species of *Pisidium* from South Dakota and Ohio.

WITMER STONE, PH.D. Four species of land shells from California.

D. THAANUM. Thirteen trays of land shells from the Hawaiian Islands.

L. E. THURSTON. *Achatinella valida kahukuensis* P. & C. from Kahuku, Oahu.

UNIVERSITY OF WISCONSIN. Six Hawaiian land shells.

BRYANT WALKER. Six trays of shells.

J. B. WALTERS AND B. LONG. Fourteen trays of shells from Red Bank, N. J.

HUGH WATSON. *Apera sexangula* Wats. from Grahamstown, South Africa.

S. G. WEIR. Nineteen trays of shells from Alabama and Tennessee.

C. S. WILLIAMSON. *Planorbis parvus* Say from Repaupo, N. J.

MISS H. WINCHESTER. Six marine shells from Wildwood, N. J.

INSECTS.

AMERICAN MUSEUM OF NATURAL HISTORY. Eleven *Conocephalus*, Cuba.

NATHAN BANKS. Three Diptera, United States. Twenty-three Neuroptera, United States.

C. T. BETHUNE-BAKER. Forty Lepidoptera, New Guinea.

HENRY BIRD. Thirty-nine Lepidoptera, United States.

W. S. BLATCHLEY. Seventy-four Coleoptera, United States (purchased).

BROOKLYN MUSEUM. *Melanoplus fasciatus*, Newfoundland.

MALCOLM BURR. Fourteen Conocephalus, Southeastern Brazil.

CALIFORNIA STATE INSECTARY. Four *Gammarotettix cyclocercus*, California (paratypes).

P. P. CALVERT, PH.D. One beetle, New Jersey.

D. M. CASTLE. Five Coleoptera, Florida.

L. CHOPARD. Seven Phasmids, Tropical America (exchange).

B. P. CLARKE. Fifty-eight Lepidoptera, California; nine *Sphingidæ;* twenty *Argynnis*, Canada.

T. D. A. COCKERELL. *Phenaspis diphonodontis* and *Phenacaspis mischocarpi*, Philippine Islands (Types); twenty-three Orthoptera, various localities.

COLORADO AGRICULTURAL COLLEGE. *Nemobius brevicaudus* (topotypes).

CORNELL UNIVERSITY. Seventeen Orthoptera, Georgia; one hundred and forty-eight Hemiptera, United States.

W. T. DAVIS. One hundred and twenty-one *Ceuthophilus*, Southern States; two Orthoptera, Georgia; one *Cicada davisi;* one *Cressonia juglandis*, North Carolina.

HENRY FOX. Two *Homorocoryphus malivolans*, Virginia; ten insects, New Jersey.

C. W. FROST. Three insects, Philadelphia; three insects, New Jersey.

GEORGIA STATE COLLECTION. Four *Ceuthophilus*, Georgia; fifty *Gryllidæ*, Georgia.

HEBARD-ACADEMY EXPEDITION, 1915. Six thousand five hundred Orthoptera.

MORGAN HEBARD. Ninety-two *Ceuthophilus*, United States; one hundred and thirty-five Orthoptera, Florida, Georgia, Virginia, Rhode Island; fifteen *Gryllidæ;* seven *Conocephalus*, Jamaica, Cuba; six Lepidoptera, Florida; three *Phasmids*, Tropical America; eighteen Orthoptera, United States; eighteen Orthoptera, Pennsylvania, New Jersey.

PHILIP LAURENT. One *Ceuthophilus*, Pennsylvania; nine *Tremex columba*, Pennsylvania; four *Ecpantheria scribonia*, Pennsylvania.

J. W. GREEN. One beetle, Texas.

C. W. JOHNSON. Seventeen Diptera, United States; Bermuda.

BAYARD LONG. One Orthopteron, Pennsylvania; one Coleopteron, New Jersey.

A. H. MANEE. Three Coleoptera, North Carolina.

L. W. MENGEL. *Papilio ascanius*, Brazil.

A. P. MORSE. Three *Gryllidæ*.

MUSEUM COMPARATIVE ZOOLOGY. Six Orthoptera.

H. A. PILSBRY. Fourteen Coleoptera, Virginia; one hundred and fifty insects, New Mexico.

PURCHASED. Two hundred and seventy-eight Orthoptera, Colombia.

C. T. RAMSDEN. Twenty-nine Lepidoptera, Cuba.

J. A. G. REHN. Three Orthoptera, New Jersey; five Orthoptera, Columbia.

JOSEPH STEIGER. Five hundred and forty-six insects, Europe and America.

WITMER STONE. Five Orthoptera, New Jersey; seven Lepidoptera, California.

UNITED STATES NATIONAL MUSEUM. Three *Phasmids*, Tropical America.

H. B. WEISS. Two *Gryllotalpa gryllotalpa*, New Jersey.

L. H. WELD. *Callirhytis furnessæ* and *Synergus furnessana*, Mexico. (paratypes).

H. W. WENZEL. One Euphoria, Texas.

E. GRACE WHITE. Two *Ceuthophilus*, Massachusetts.

John H. McFadden. Twenty-eight species of invertebrates from South Victoria Land and New Zealand; Sir Ernest Shackleton's Collection.

Clarence B. Moore. Balanus from Mobile Bay, Alabama.

C. R. Orcutt. Two species of Crustacea (purchased).

Miss R. M. Pierce. *Balanus ebürneus* Gld. from Wildwood, N. J.

H. A. Pilsbry. Sixteen species of invertebrates from Arizona and Hawaiian Islands.

C. T. Ramsden. Small collection of crabs, Guantanamo, Cuba.

S. N. Rhoads. Two crabs from Panama.

S. Raymond Roberts. Nine species of invertebrates from Massachusetts and West Indies.

United States Fish Commission. Anemone from off Cape Cod, Mass.

Geology.

John H. McFadden. Series of Antarctic geological specimens; Sir Ernest Shackleton's Collection.

Vertebrate Fossils.

Bayard Long. Three fossil fish teeth.

University of California. Mandible of *Smilodon* sp., Pleistocene of Rancho La Brea, Cal.

Frank D. Butler. (On deposit) two tusks of Mammoth, Alaska.

Invertebrate Fossils.

John Ford Collection. Two species of fossil *Oliva* from North Carolina and Florida (purchased).

Robert W. Hendy. *Livona pica* L. from the Post-Pliocene at Horse Hill, Barbados.

Mrs. M. K. Langsdorf. One hundred and sixty-five trays of Devonian fossils from Canandaigua, N. Y.

Bayard Long. Fifteen trays of Cretaceous fossils from Blackwood and Vincentown, N. J.

Albert Moore. *Belemnites americana* Morton from the Cretaceous at Barnesboro, N. J.

Clarence B. Moore. *Athyris tumida* Dalm. from the Upper Silurian at Dixie Landing, Tenn.

New York State Museum. *Hydnoceras bathense* H. & C. from Bath, N. Y.

Plants.

A. Allann. *Muscari comosa.*

E. B. Bartram. Twenty-two sheets of local plants.

E. B. Bartram and Bayard Long. Two hundred and fifty sheets from Eastern Quebec.

Wm. G. Bassett. *Hypopitis*, sp.

O. H. Brown. Seventy-five sheets of New Jersey plants.

Joseph Crawford. Four sheets of local plants.

Dr. J. W. Eckfeldt. *Quercus rudkini.*

M. L. Fernald and Bayard Long. Six hundred and fifteen sheets of plants from Block Island and Massachusetts.

Wm. Findley. Seven sheets of local plants.

H. L. Fisher. *Malus parviflora.*

Dr. C. D. Fretz. Eighteen sheets of local plants.

E. K. Gale. *Juncus gerardi.*

J. H. Grove. Seventy-nine sheets of New Jersey plants.

Daniel W. Hamm. Thirty-three Pennsylvania plants.

Lewis S. Hopkins. *Lepidium perfoliatum* and *Isoëtes braunii.*

Bayard Long. Two hundred and twenty-eight sheets of local plants.

K. K. Mackenzie. *Gnaphalium helleri.*

J. H. Mumbauer. *Phegopteris dryopteris.*

Francis W. Pennell. Three hundred and thirty-two sheets of local plants.

Howard W. Pretz. Nine hundred and sixty-eight sheets of plants from Lehigh County, Pa.

Mrs. Joseph Rhoads. Herbarium of James and Joseph R. Rhoads of Haddington, Philadelphia, made in 1858 to 1865.

Harold St. John. *Carex platyphylla.*

Witmer Stone. Twenty-five sheets of plants from Minnesota and *Senecio crawfordi*, New Jersey.

University of Pennsylvania. Sixty-five sheets of *Gerardia*, etc., collected by F. W. Pennell. Two hundred and sixty-nine specimens of local plants in exchange.

J. B. Walter. *Ilex* and *Viola.*

Robert Welsh. *Hydrastis canadensis.*

Alma Wilson. Three sheets of local plants.

Archæology and Ethnology.

George Apperley. Two flint instruments from Wheeler, Indiana.

Dr. Edwin Atlee Barber. Section of vegetable fibre rabbit net and section of feather rope, found in earthen jar buried in ancient cliff dwelling in Utah.

Wm. L. Fanshawe. Three stone implements from Plymouth Meeting, Pa.

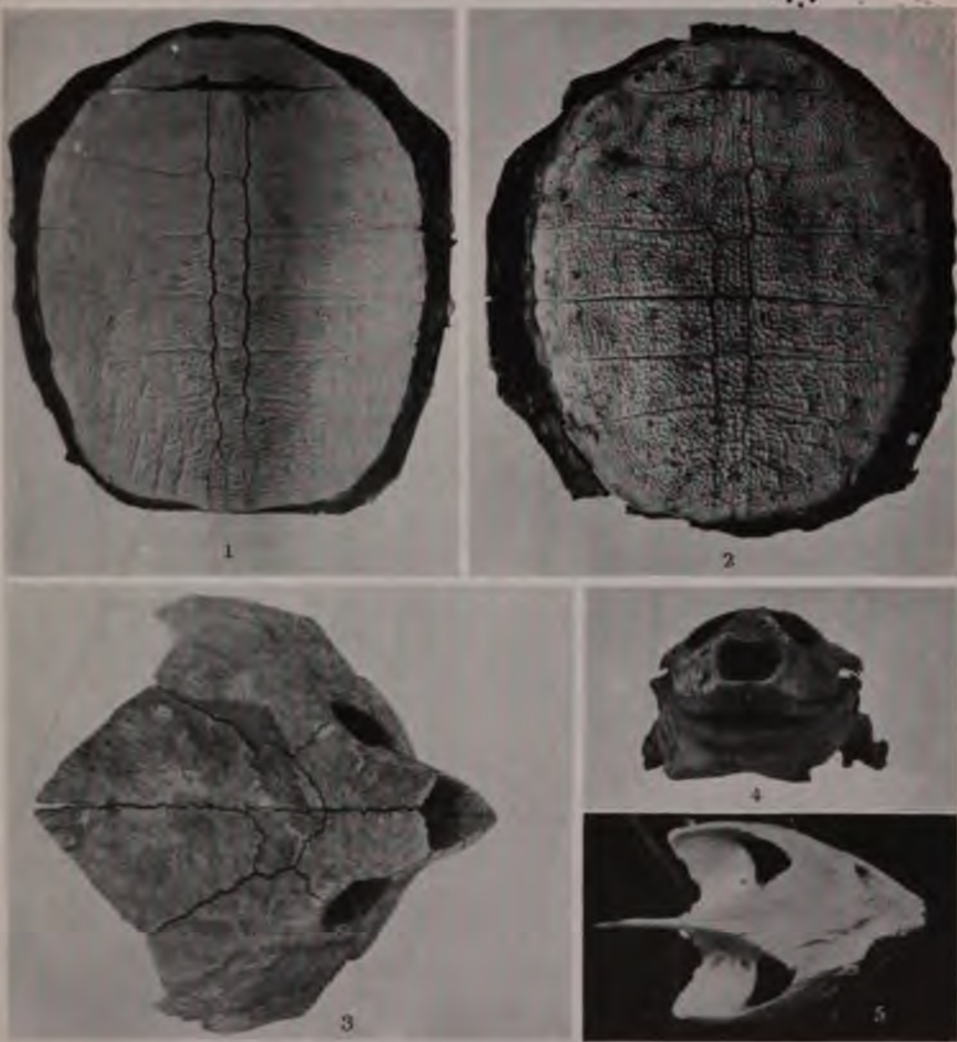
Mrs. J. F. Holt. Eleven ethnological specimens from Greenland.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1915.

Species described as new are indicated by heavy-faced, synonyms by italic numerals.

GENERAL INDEX.

1915.



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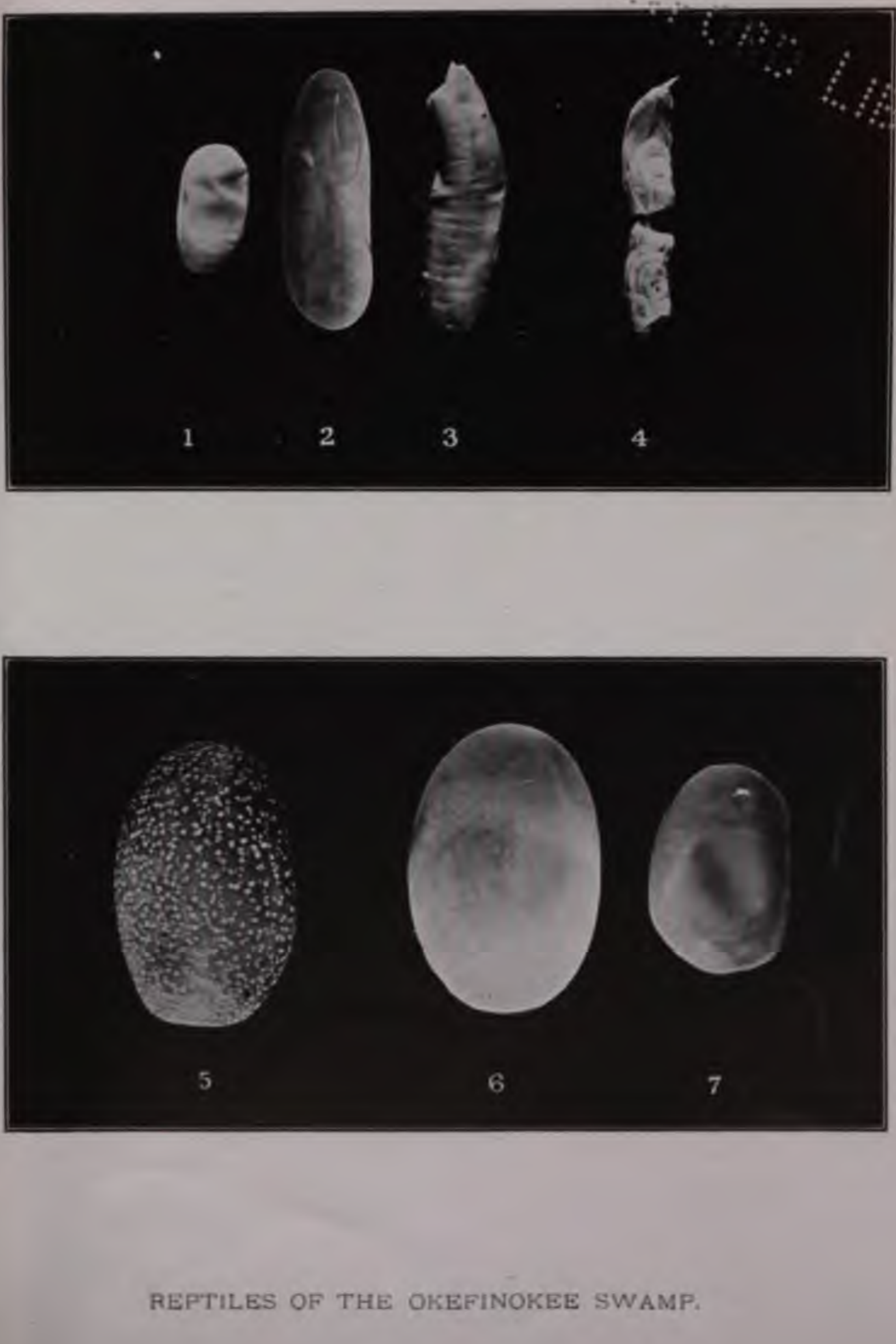

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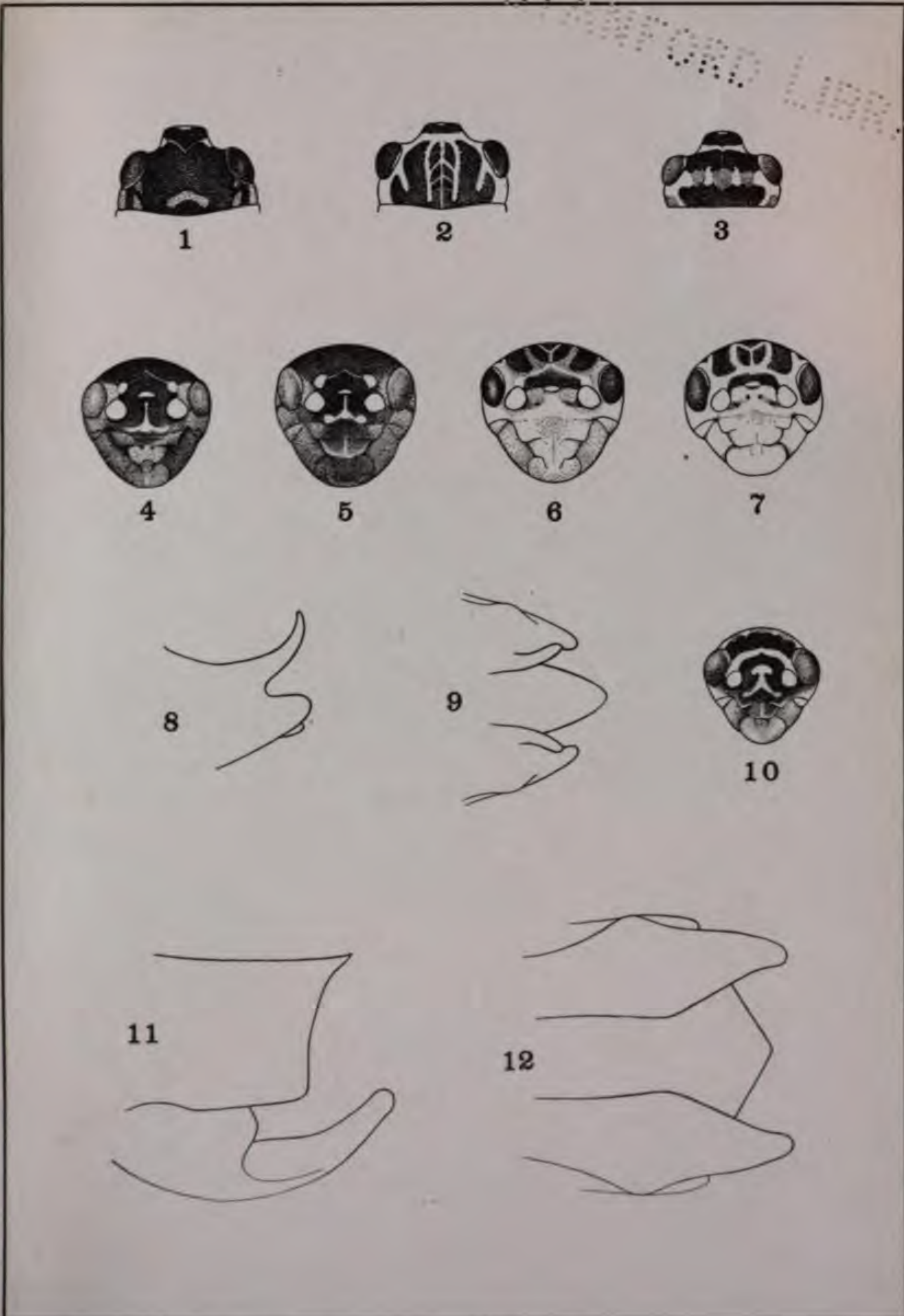
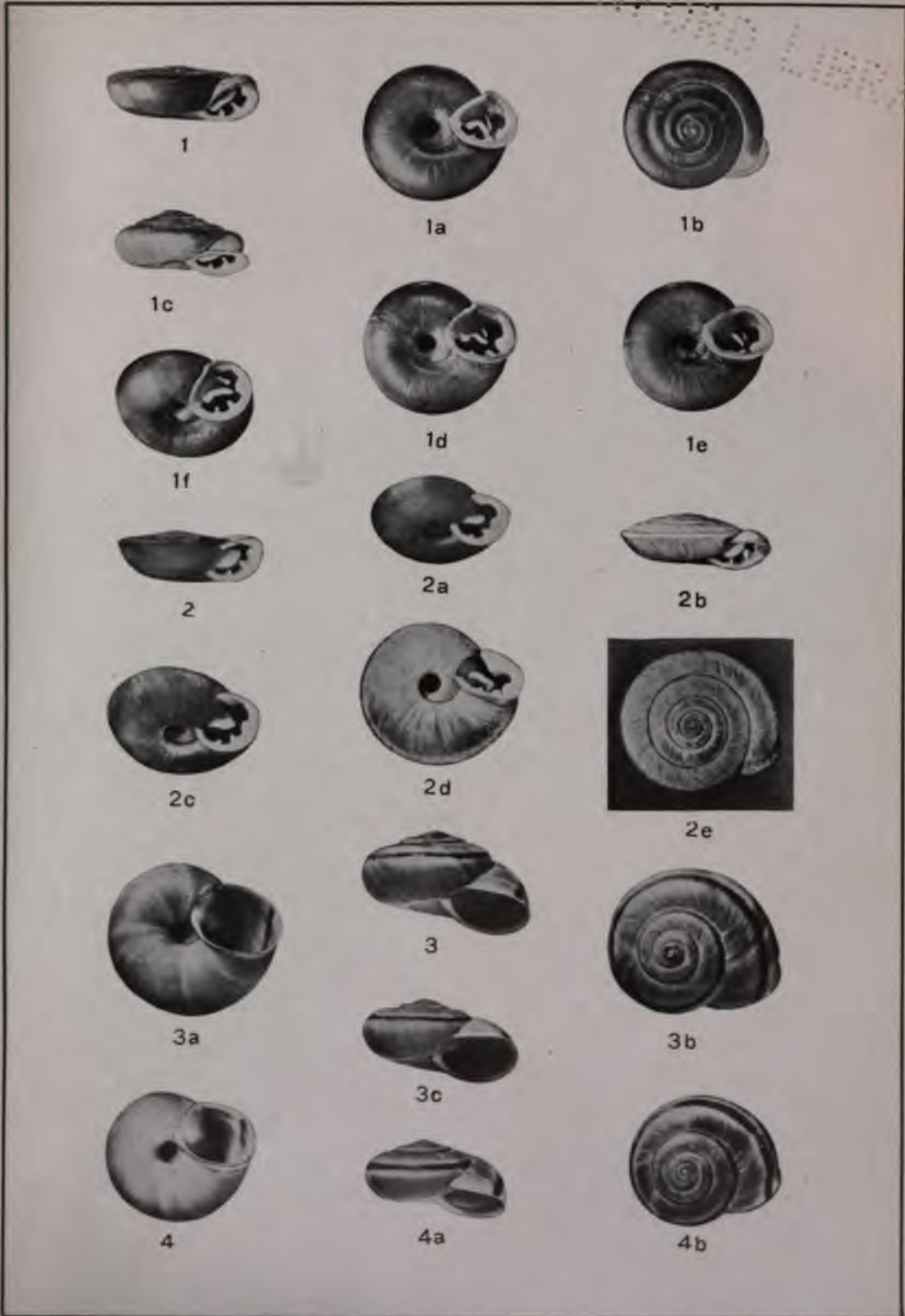


REHN AND HEBARD: THE GENUS GRYLLUS.



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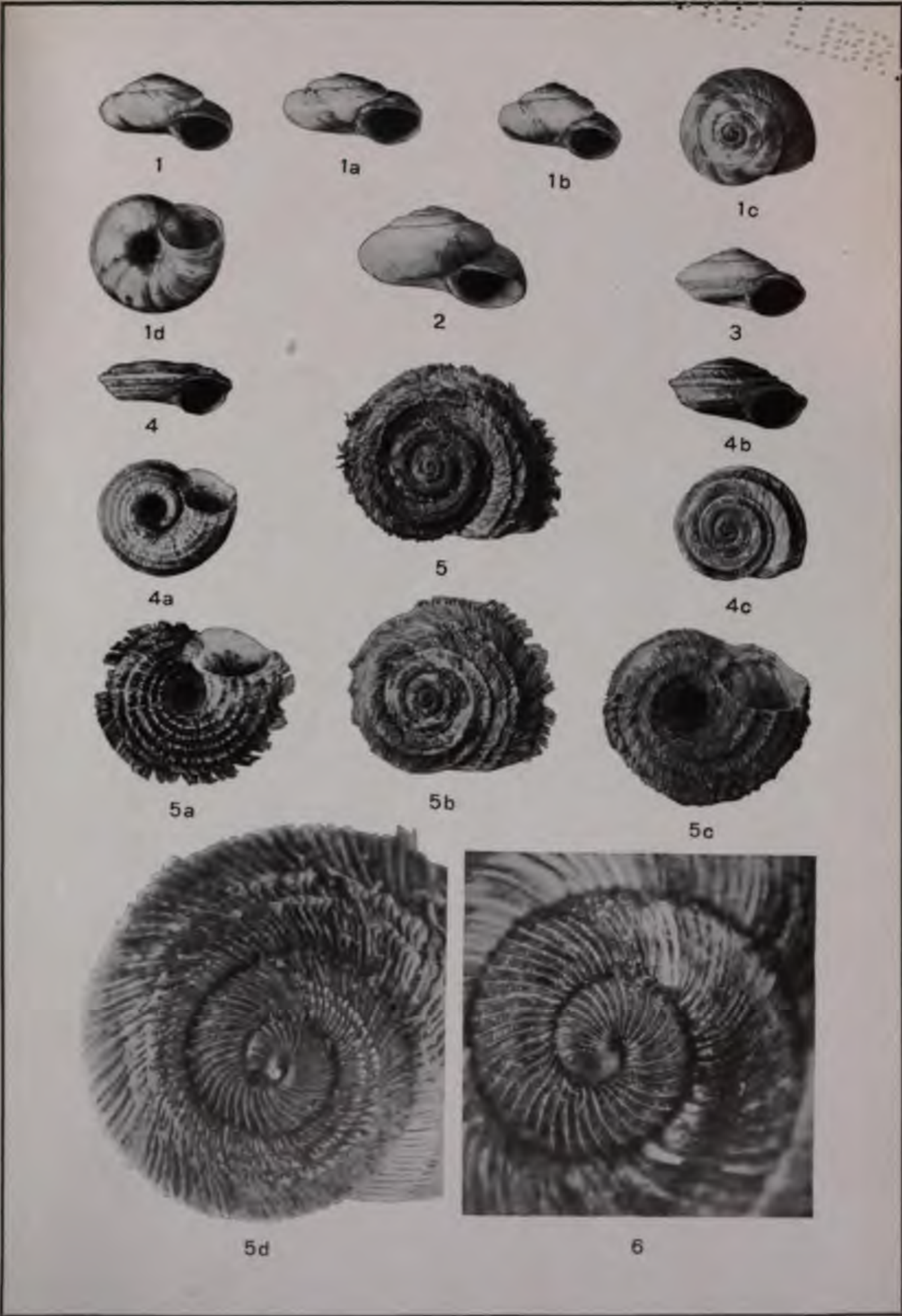

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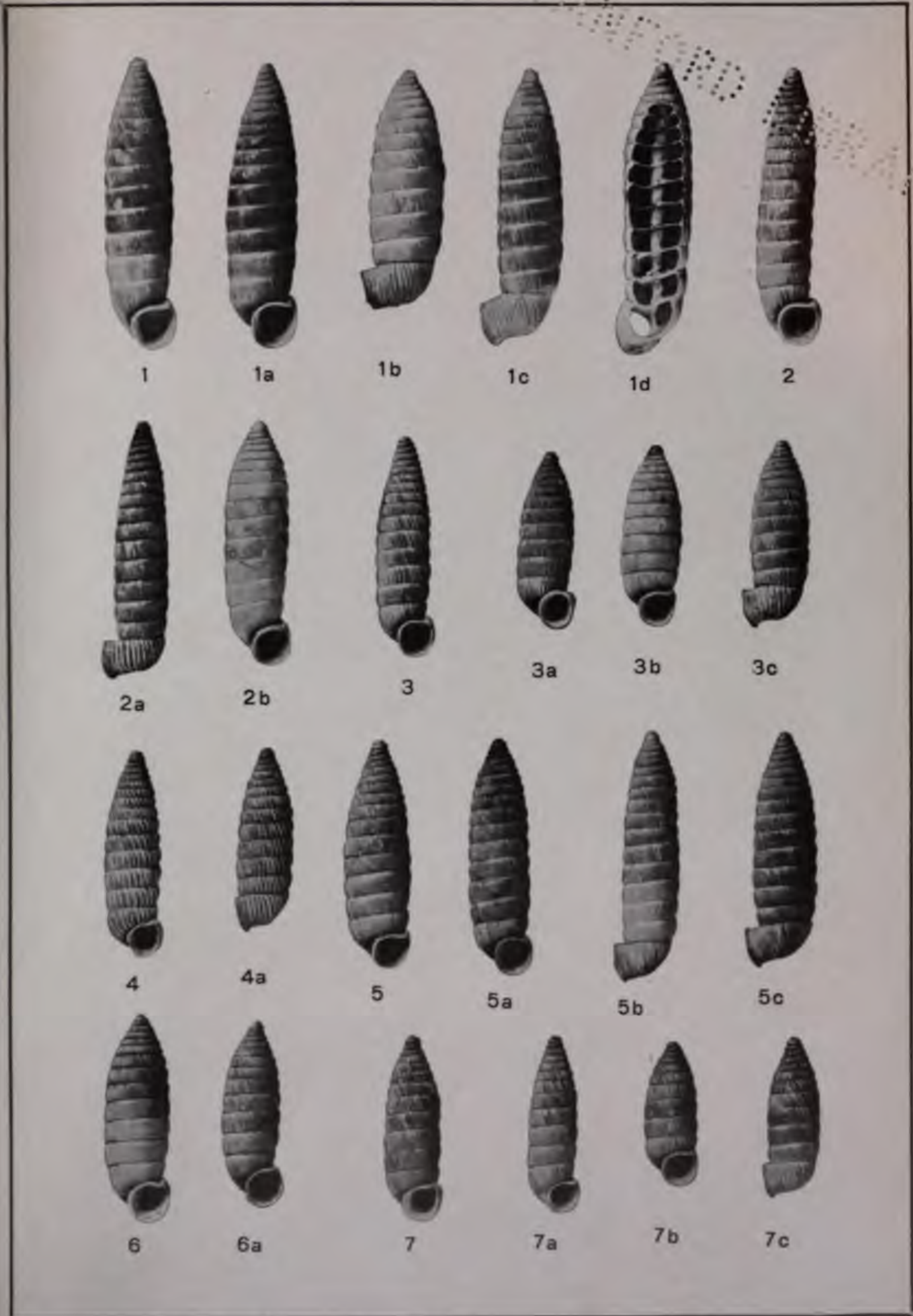

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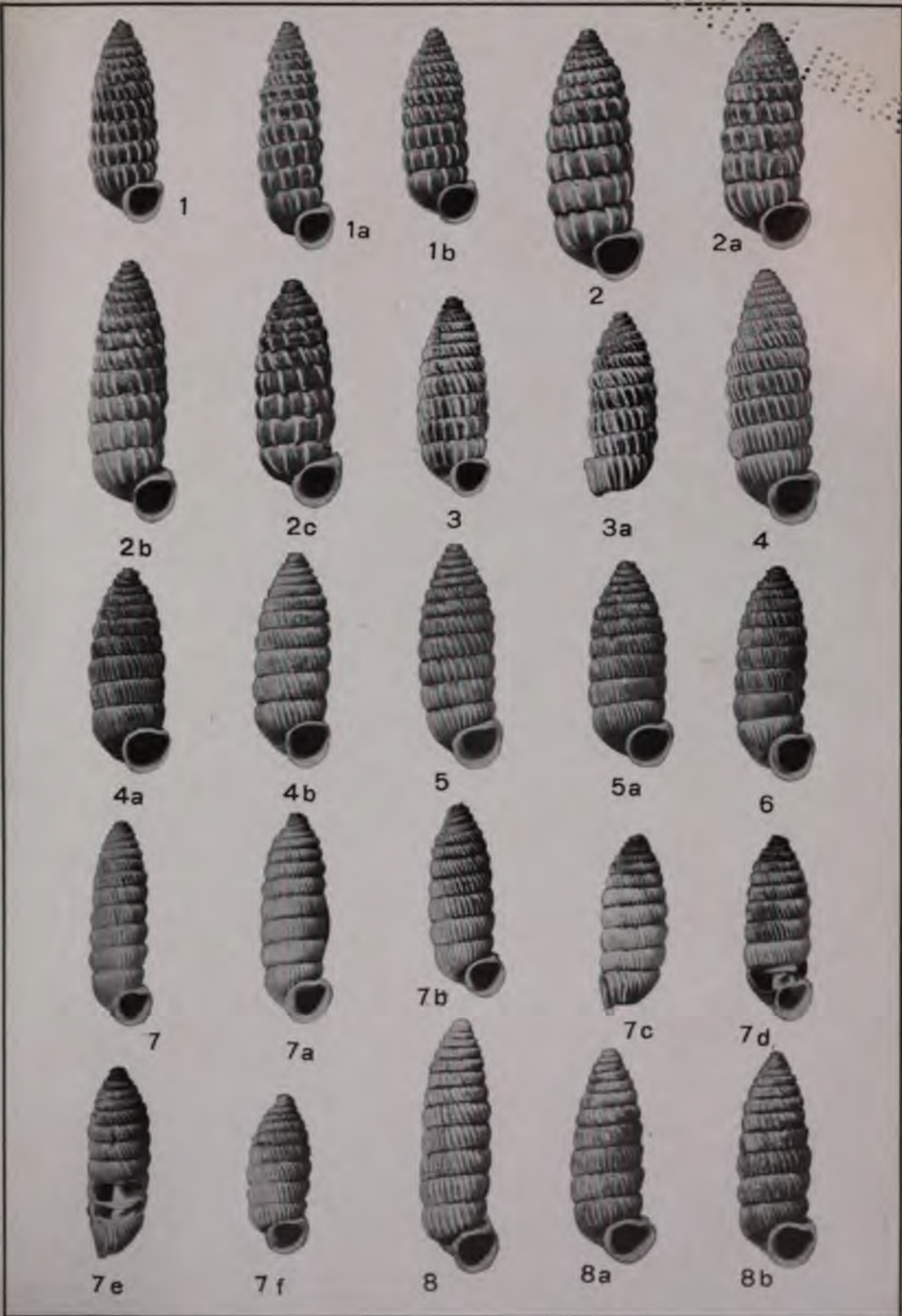

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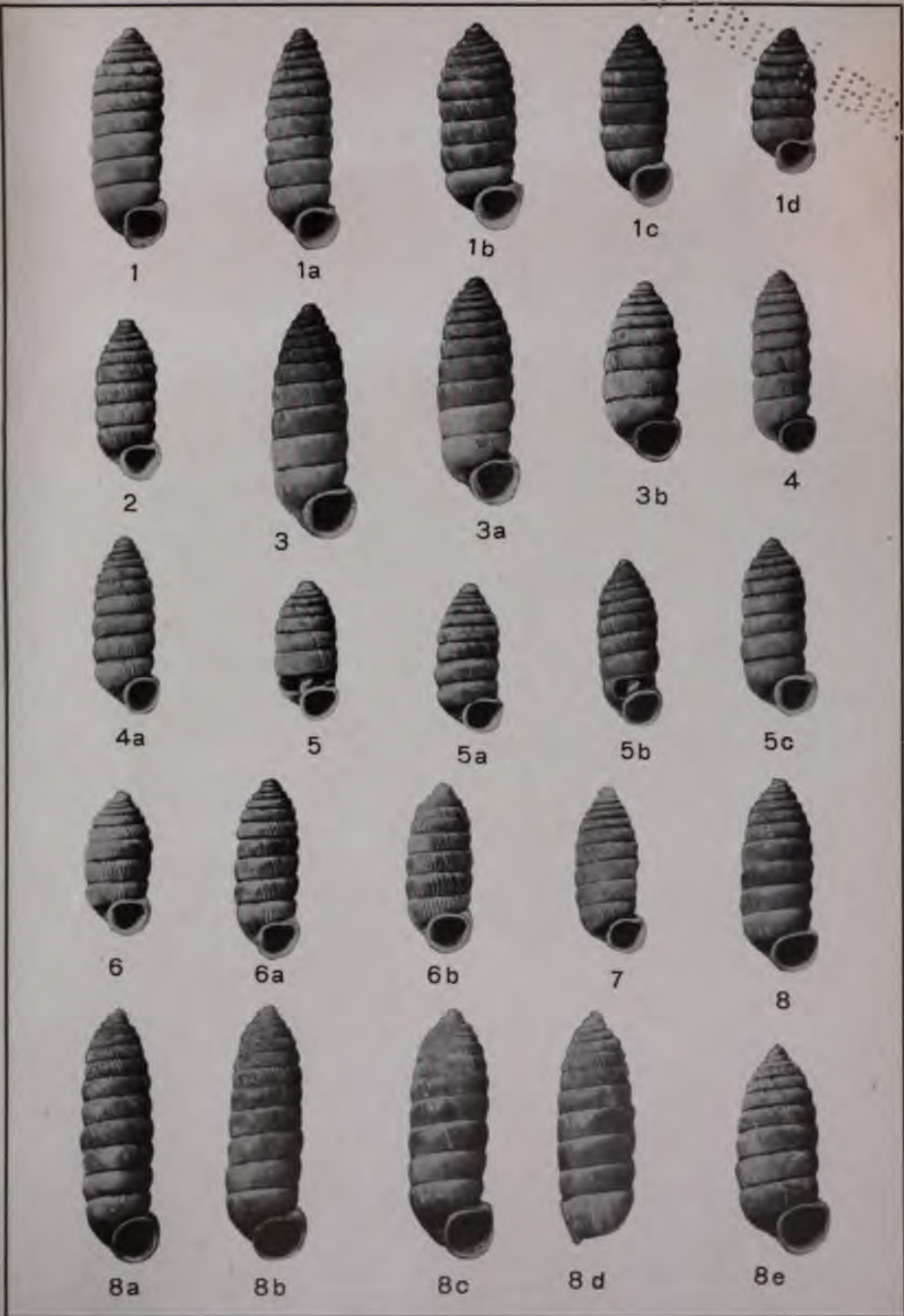

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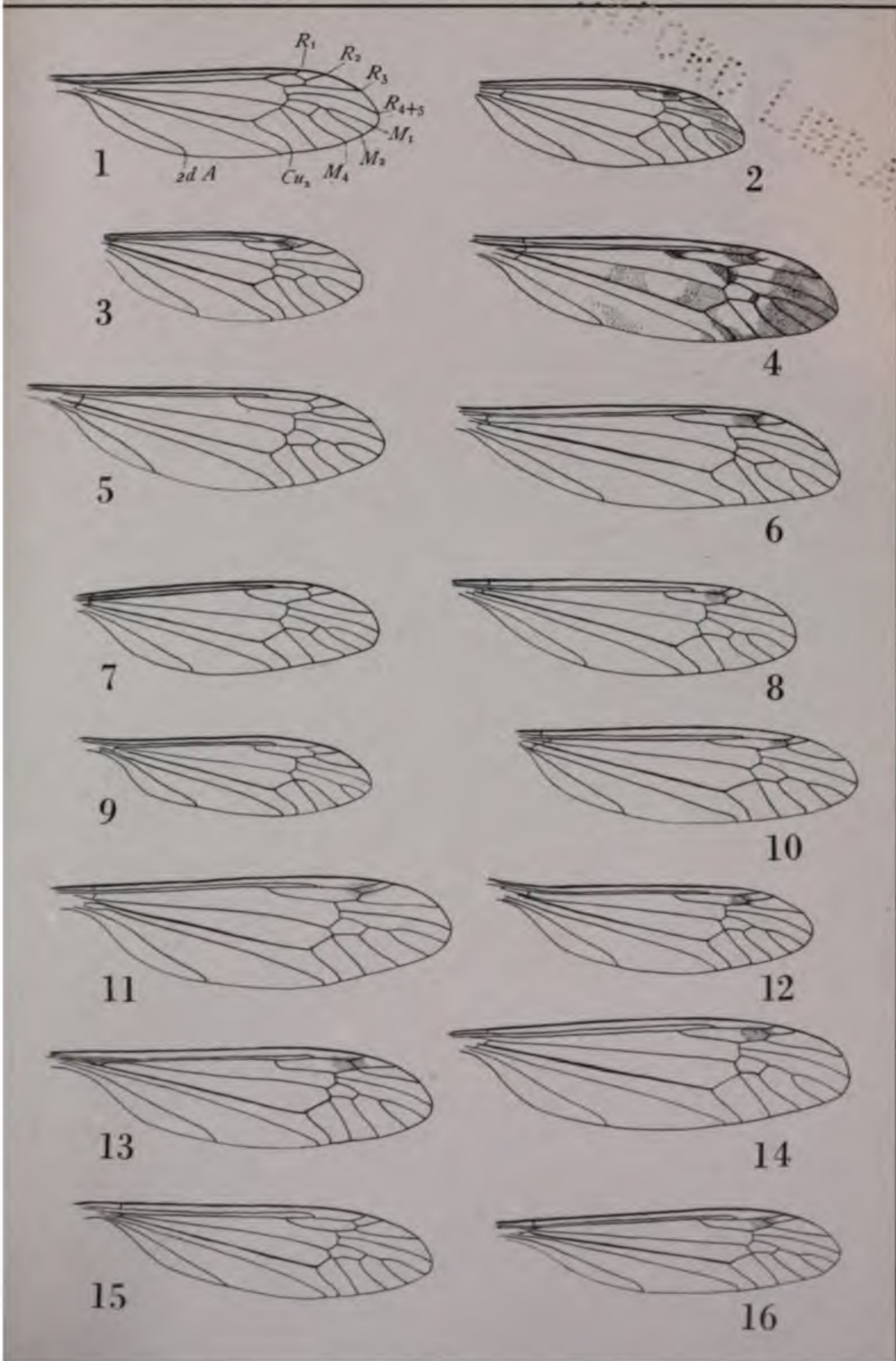

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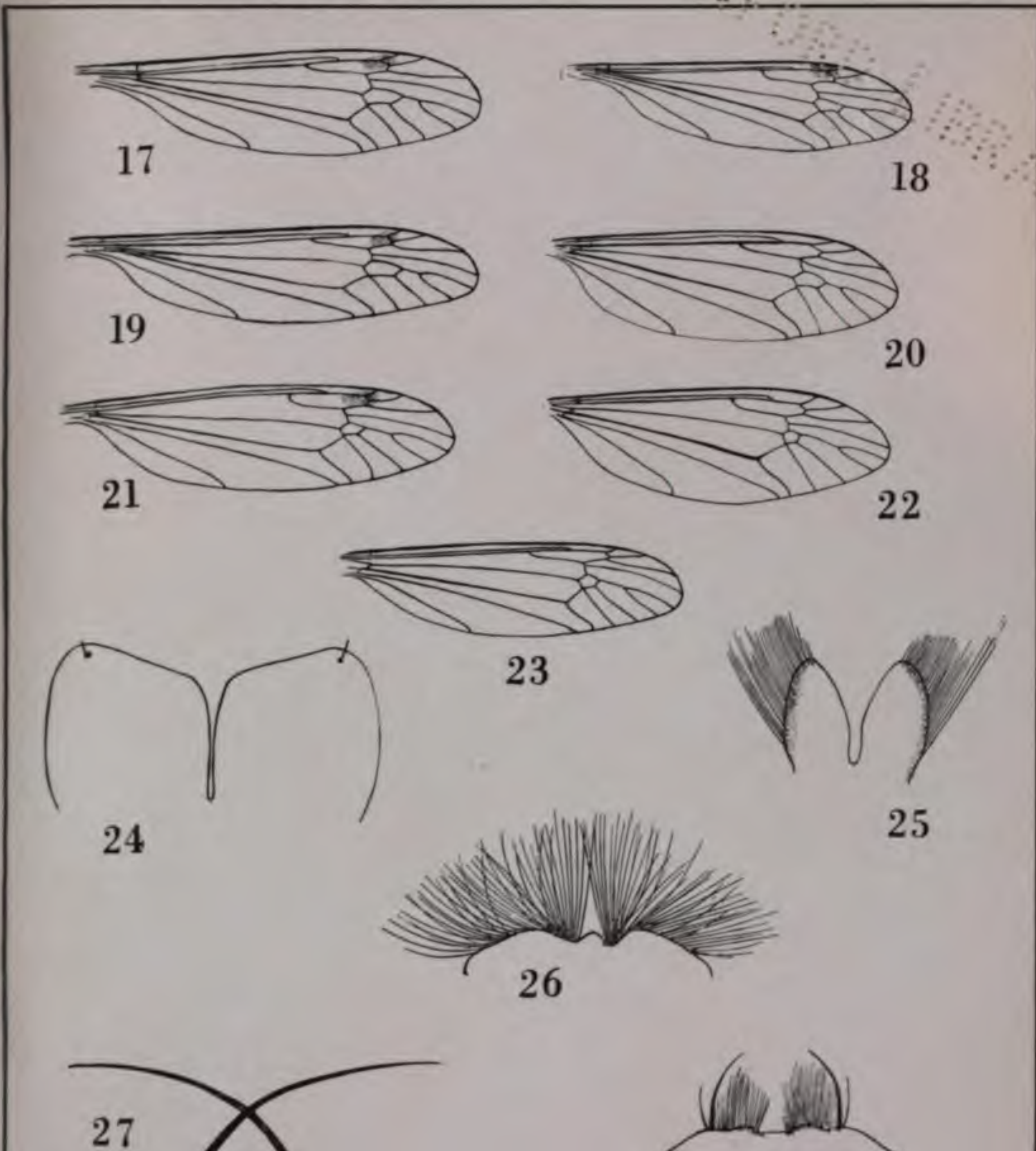

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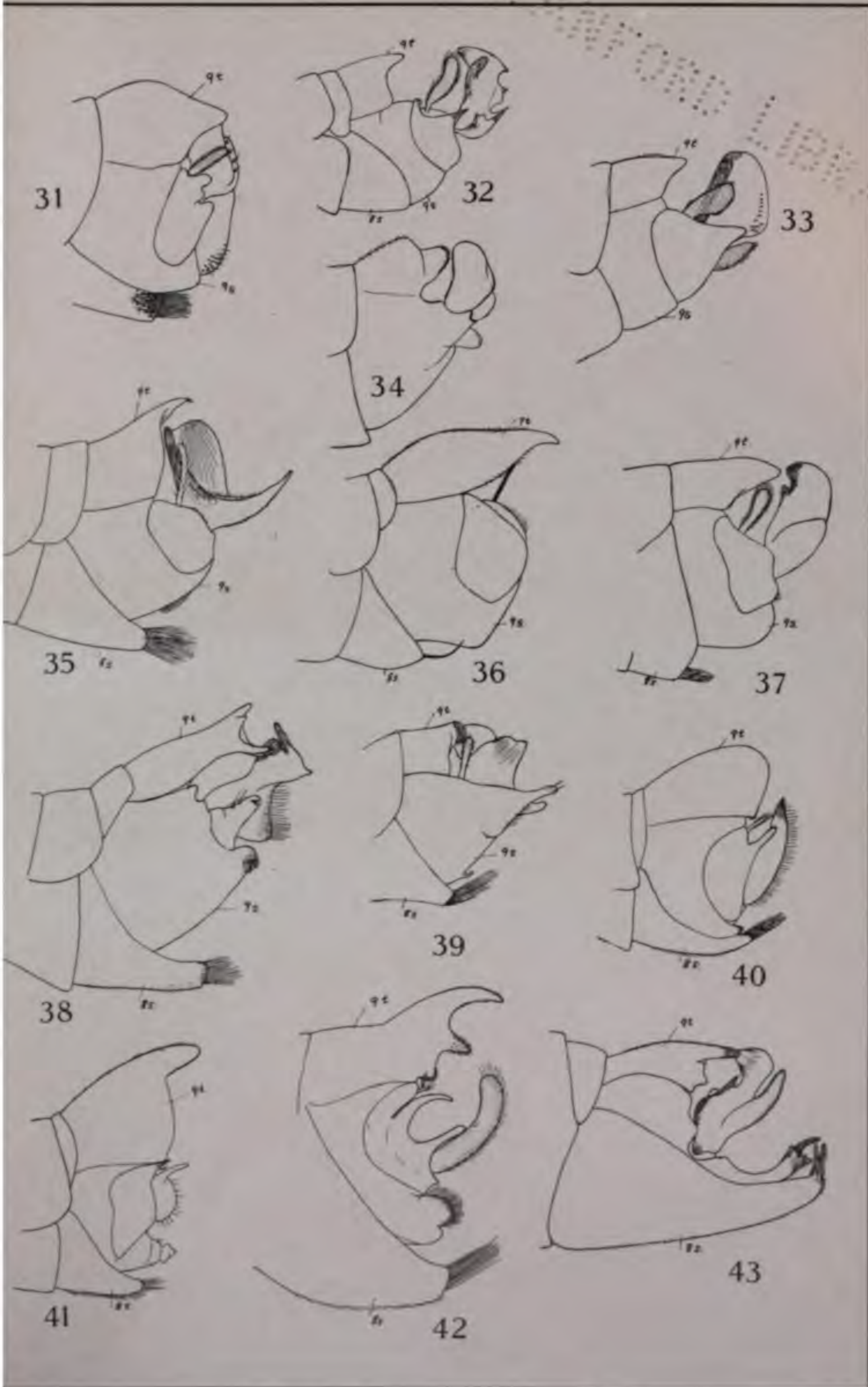

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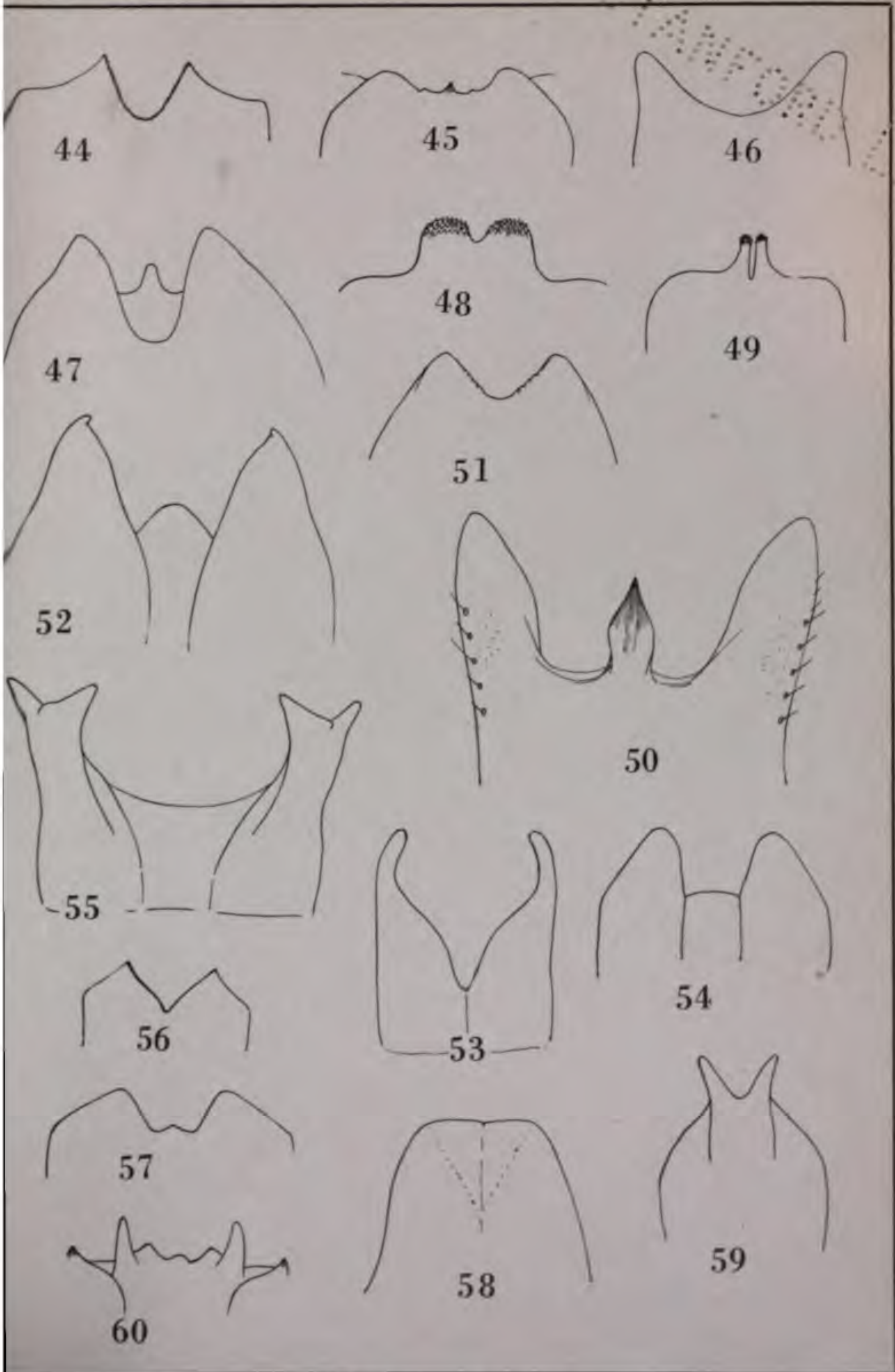

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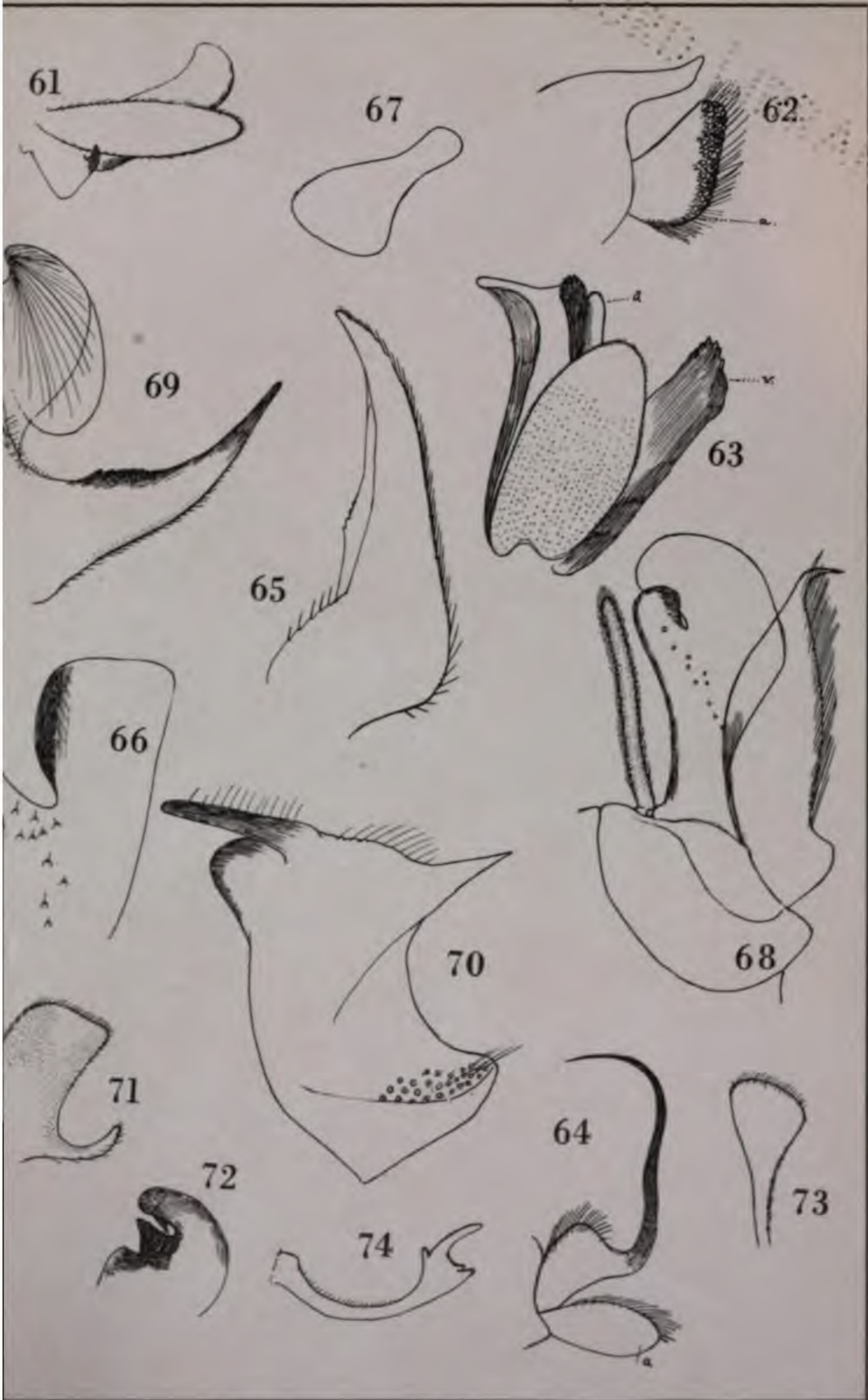

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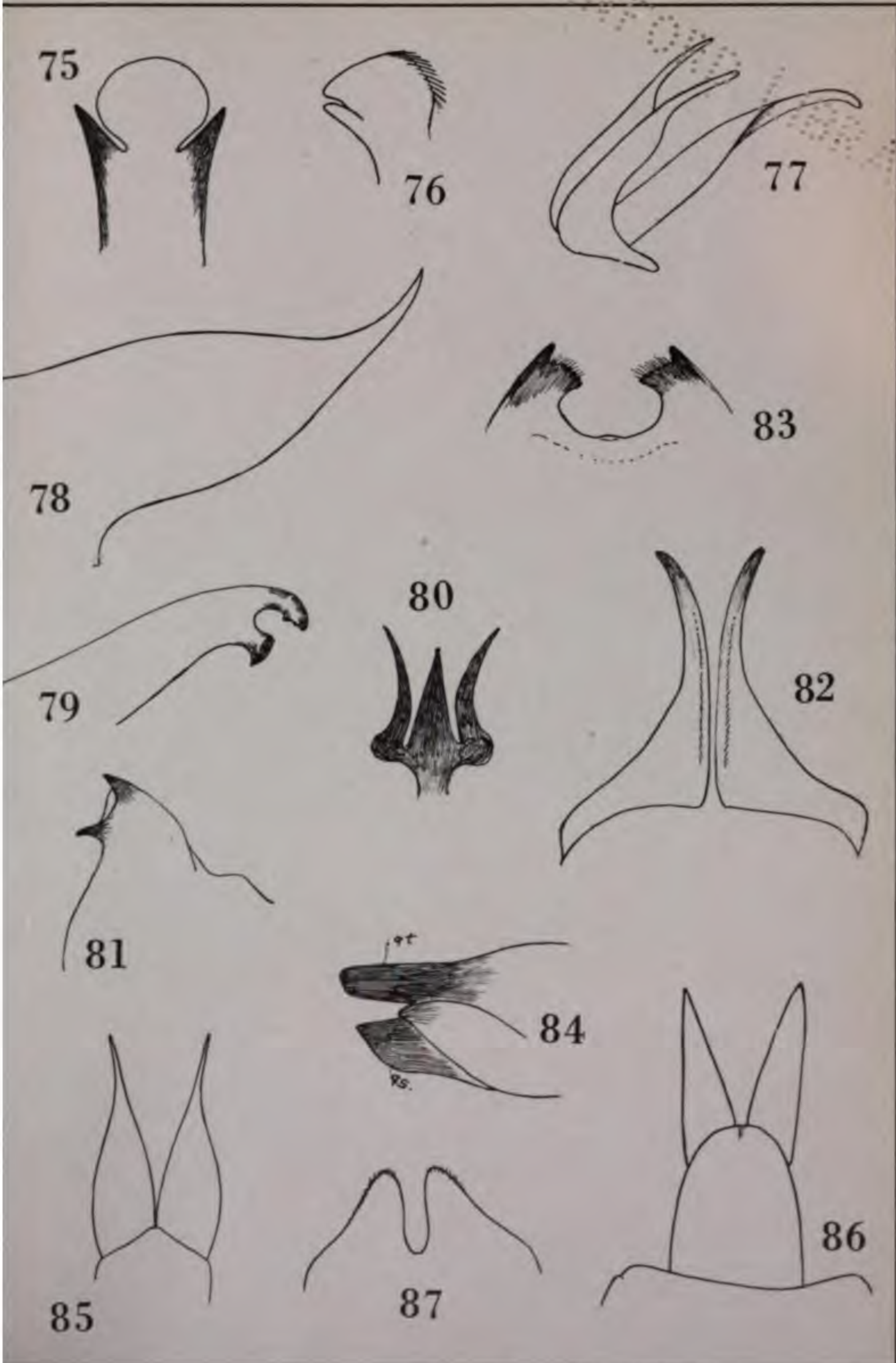

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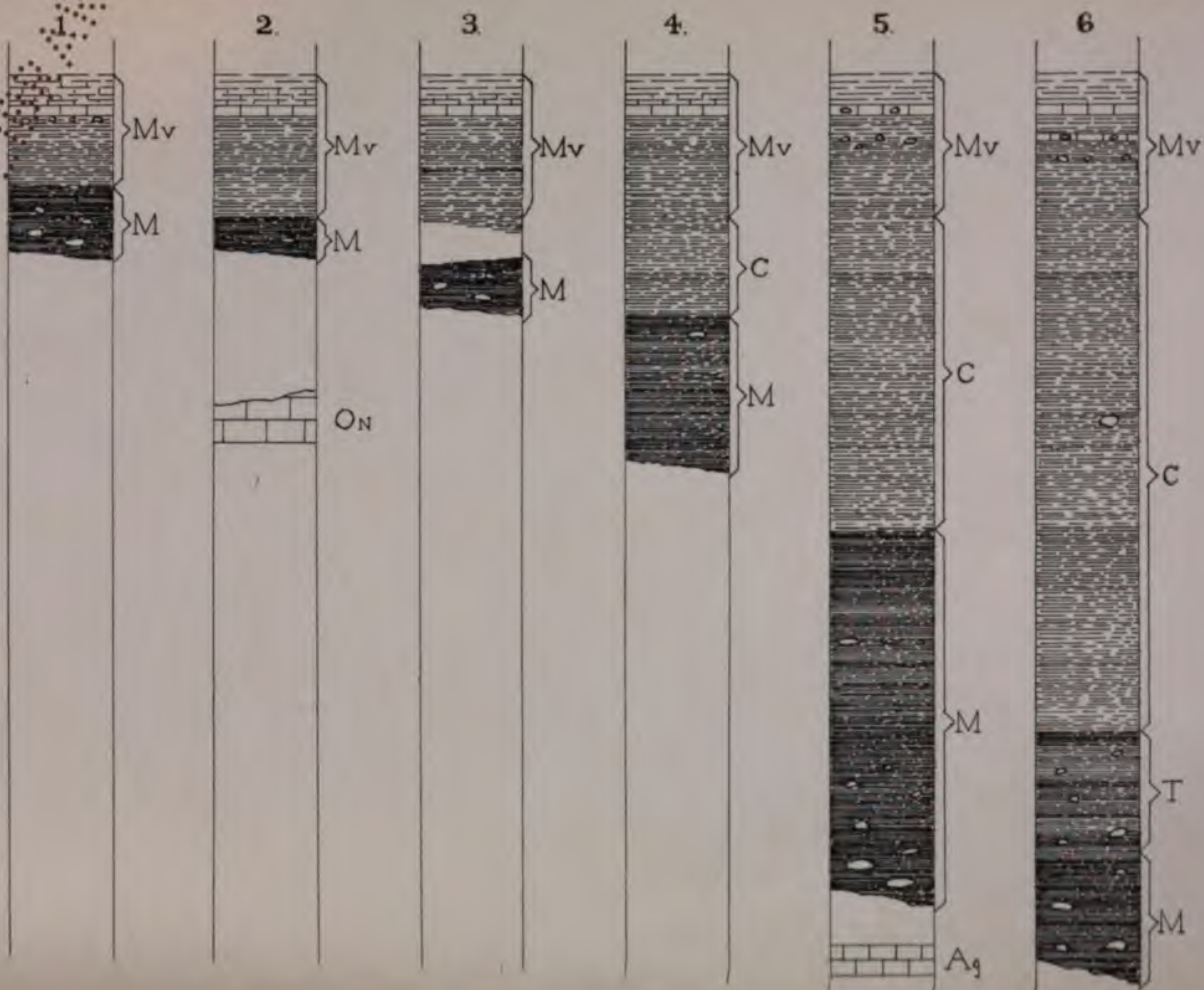
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PROCEEDINGS

OF

The Academy of Natural Sciences

OF

PHILADELPHIA

VOLUME LXVII

PART I. JANUARY, FEBRUARY, MARCH,

1915

THE ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA

1915

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April, 1915.

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OF THE

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OF

PHILADELPHIA

VOLUME LXVII

III. SEPTEMBER, OCTOBER, NOVEMBER, DECEMBER,

1915

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OF

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1916

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January, 1916.

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